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PROGNOSIS IN GIANT-CELL SARCOMA OF THE LONG BONES 321
William B. Coley, M.D. ..... New York, N.Y.

ADAMANTINE EPITHELIOMA OF THE LOWER JAW 358
J. Shelton Horsley, M.D. ..... Richmond, Va.

THE MATAS OPERATION FOR ANEURISM 370
Hermann B. Gessner, M.D. ..... New Orleans, La.

AN IMPROVED METHOD OF REMOVING HERNIA FROM WITHIN 375
G. Paul LaRoque, M.D. ..... Richmond, Va.

HEMORRHAGE IN INJURIES OF THE ABDOMEN 382
James Monroe Mason, M.D. ..... Birmingham, Ala.

PARTIAL GASTRECTOMY FOR GASTROJEJUNAL ULCER 386
Donald C. Balfour, M.D. ..... Rochester, Minn.

SURGERY OF RENAL TUBERCULOSIS 395
Edward S. Judd, M.D. and Albert J. Scholl, M.D. ..... Rochester, Minn.

PILONIDAL SINUS 410
Harvey B. Stone, M.D. ..... Baltimore, Md.

COMPLETE OUTWARD DISLOCATION OF THE PATELLA 415
Nathan Winslow, M.D. ..... Baltimore, Md.

PRIMARY PERITONITIS 418
Arthur A. Zierold, M.D. ..... Minneapolis, Minn.

RECENT CONTROVERSIAL QUESTIONS IN GALL-BLADDER SURGERY 424
Walton Martin, M.D. ..... New York, N.Y.

ANÆSTHESIA OF THE SPLANCHNIC NERVE IN ABDOMINAL OPERATIONS 444
Hermann Fischer, M.D. ..... New York, N.Y.

AN IMPROVED ABDOMINAL RETRACTOR 454
Joseph L. DeCourcy, M.D. ..... Cincinnati, O.

TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY 455
Stated Meeting Held November 28, 1923
Stated Meeting Held December 12, 1923

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ANNALS of SURGERY

VOL. LXXIX MARCH, 1924 No. 3

PROGNOSIS IN GIANT-CELL SARCOMA OF THE LONG BONES*

BASED UPON THE END-RESULTS IN A SERIES OF 50 CASES

BY WILLIAM B. COLEY, M.D.
OF NEW YORK, N. Y.

THE theory that giant-cell sarcoma is always a benign lesion and never metastasizes dates back to the middle of the nineteenth century. In 1854, Sir James Paget, in his lecture on Surgical Pathology (Lecture 28, part 1, p. 446) gives Lebert (Physiologie Patholog., D. Balliere, 1845, vol. ii, p. 120) full credit for being the first one to describe giant-cell tumors. Paget himself, nine years later, gave a most accurate description of these tumors, which, Bloodgood well says, has never been improved upon by any subsequent writer. A portion of Paget's description is well worth quoting:

> "The cut surface appears smooth, uniform, compact, shiny, succulent, with a yellowish not a creamy fluid. The cut surface shows blotches of dark or livid crimson or brownish or bright-blood color, or pale pink, or all of these tints mingled, on the grayish-white or greenish basis color. The tumor may be all pale or have a few points of blotching on the cut surface; or may be nearly all suffused like the cut surface of the heart of spleen."

After a study of Lebert's cases, as well as a few of his own, Paget very modestly concludes that his observations are too few and too various to warrant many general conclusions. Those which he tentatively expressed, however, were:

> "The tumor is single, occurs most frequently in youth, rarely in adult age, is slow in growth, and without pain, and generally comes on without any known cause such as injury; has no tendency to ulcerate. * * * They may (but I suppose very rarely) cease to grow. They are not apt to recur after complete removal, nor have they in general any features of malignant disease."

And then, at the end, Paget very wisely adds, that while these and many other cases may be enough to prove that the myeloid tumors are generally of an innocent nature, "still, I suppose, cases may be found in which, with the same apparent structure, a malignant course is run." Further observations have shown some of Paget's conclusions to be incorrect. We now know that injury is a very important factor as an exciting cause; not less than fifty-six per cent. of my series of cases give a distinct history of antecedent local injury. We also come to recognize pain as one of the earliest and most constant symptoms.

Nélaton in 1860, published the most lengthy monograph on the subject

* Read before the Southern Surgical Association, December, 1923.

that has ever been written, further strongly advocating the view that giant-cell tumors are only locally malignant, and furnishing much new data in support of this view. Bloodgood for many years has upheld this doctrine, and it is not too much to say that at present the majority of pathologists here and in Europe have accepted it. This view has been expressed so often and

FIG. 1.—(Case No. 1 in text.) Sarcoma of humerus; microscopical diagnosis; giant-cell sarcoma. Amputation; death 15 months later from metastases in lungs.

so emphatically that many surgeons have accepted it without a sufficiently careful or critical examination of the data upon which it is founded.

When I became interested in the study of long-bone sarcoma more than twenty-five years ago, I had no definite opinions as to whether the central giant-cell sarcomas were benign or malignant. I did, however, keep a careful record of the cases and followed up the end-results in the great majority. An analysis of these end-results should be of interest to the surgeon, and should furnish additional data upon which to base an opinion in regard to the prognosis of giant-cell sarcoma. Furthermore, this study

should give some help in determining the choice of method in the treatment of these tumors.

Let us begin by attempting to describe what is meant by giant-cell sarcoma. Various names have been given it, beginning with tumeur à

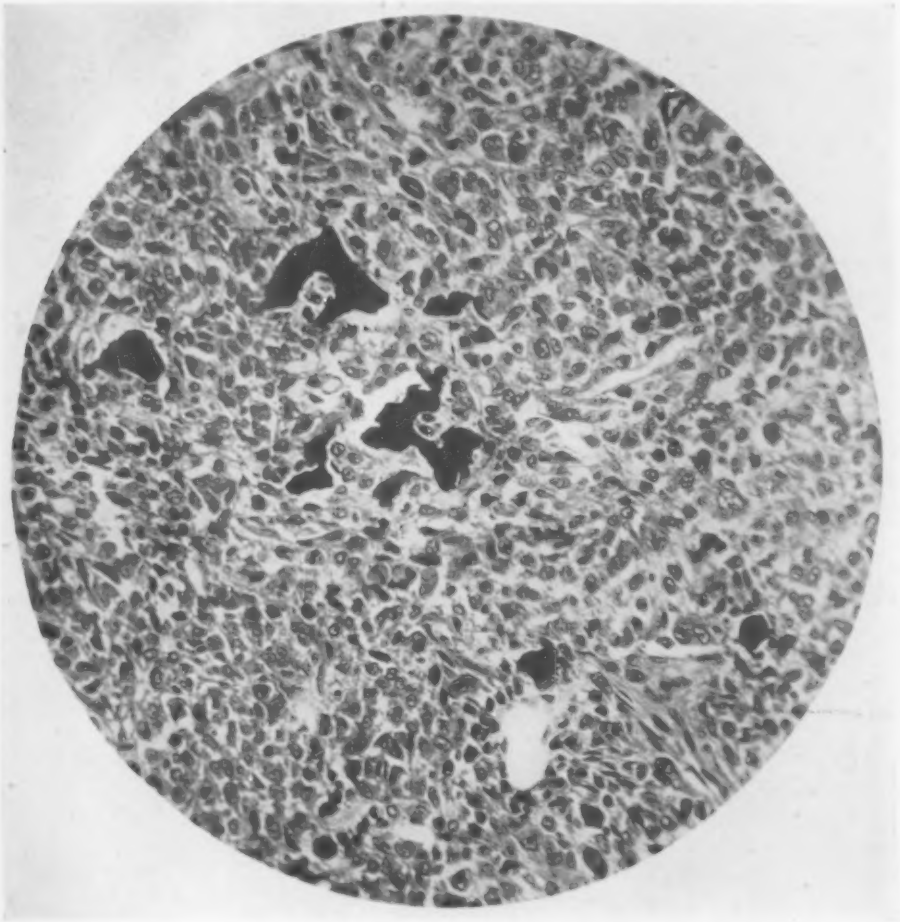

FIG. 2.—(Case No. 2 in text.)

myéloplaxes (by Nélaton), myeloid sarcoma—a name almost universally used from 1870 to 1910, and still used in British literature, giant-cell sarcoma, benign giant-cell sarcoma of the epulis type, giant-cell tumor (Bloodgood), osteitis fibrosa cystica (von Recklinghausen), hemorrhagic osteomyelitis (Barrie). The term most generally used to-day is giant-cell tumor or giant-cell sarcoma of the epulis type.

Clinical Description of the So-called Benign Giant-cell Sarcoma.—My own series shows that the disease had existed less than six months in 50 per cent. of the cases and more than one year in only six cases. This tumor is usually said to be of long duration and slow growth, but this is by no means

always true, it is situated near the extremity of one of the long bones; the upper end of the tibia, lower end of the radius, and lower end of the femur is the most frequent site; although it may occur in any of the bones. Of other bones, the lower jaw is the most frequent site. There is usually a history of antecedent injury; some writers say it is practically always the result of trauma. My series shows trauma in 56 per cent. of the cases. In

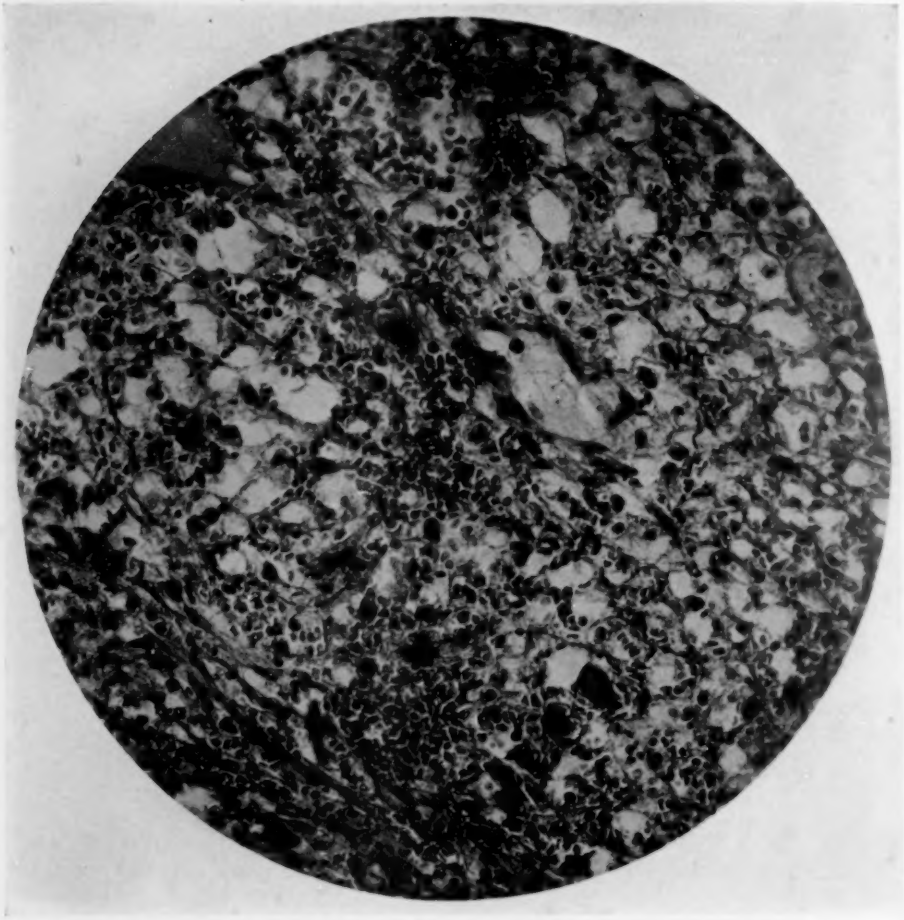

FIG. 3.—(Case No. 2 in text.)

a few cases (5) it has followed a recent fracture. It gradually expands the bone, destroying the bone slowly by absorption, but rarely breaking through the periosteum, and still more rarely invading the neighboring joint. If the bony shell overlying the tumor is very thin, a peculiar "egg-shell" like crackling may be elicited on pressure; this, however, is so seldom seen that it is of little practical value in making a diagnosis. In some cases the superficial veins are enlarged. Pain is one of the earliest symptoms and is usually more severe than in the periosteal type. Limitation of function will depend on the size and location of the tumor. X-ray examination will show a fairly

characteristic appearance. The centre of the bone will show a more or less complete destruction of bone, leaving a shell of bone of varying thickness. The periosteal line is rarely invaded, except in far advanced cases. In some cases, but not in the majority, the area occupied by the tumor has a multi-

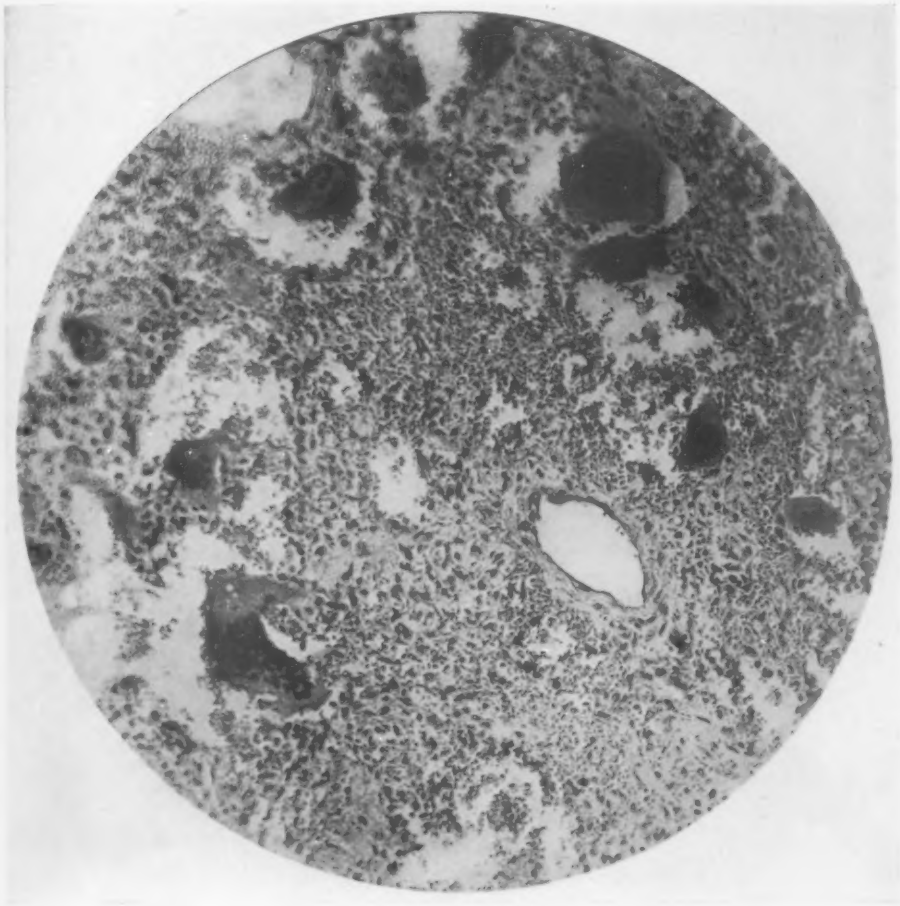

FIG. 4.—(Case No. 2 in text.)

cystic appearance. The X-ray picture cannot always be differentiated from a malignant central sarcoma.

Gross Appearance of the Tumor.—The tumor tissue is usually made up of solid portions and numerous small cysts filled with yellow or reddish serum. The solid portions are friable in consistence, and vary in color from a yellow to a dark red. They often look like a portion of liver. These tumors are often of great vascularity and there may be difficulty in controlling the hemorrhage after curetting.

One of the most recent contributions to the subject has been made by Martland (Proceedings of the New York Pathological Society, 1921, vol. xxi, Nos. 1–5, p. 102), who for many years has been very much interested in bone tumors, especially of the giant-cell type. He states that, "Benign

giant-cell tumor, medullary giant-cell sarcoma, giant-cell sarcoma of the epulis type, medullary giant-cell tumor, chronic non-suppurative hemorrhagic osteomyelitis (Barrie), etc., has been recognized for many years by a few surgeons and pathologists as essentially a benign lesion of bone. This fact, however, is unfortunately not appreciated by most surgeons, in spite of all the literature written on the subject."

Martland gives a very good description of these tumors. He states that, "In gross appearance the tumor is usually confined within the periosteum, definitely circumscribed, not infiltrating, and is easily removed from its bony shell. It is distinctly vascular, simulates young granulation tissue, is friable, soft, oozes and resembles red-currant jelly or fresh-cut liver." This coincides very closely with the description given by Nélaton in 1860.

Martland refers to two cases that had come under his observation, one for a period of ten years; a benign giant-cell tumor of the lower end of the tibia, which lesion had been curetted several times.

In conclusion, Martland states, "From my observations in these two cases, I am of the opinion that so-called benign giant-cell tumor is entirely an inflammatory process in the nature of exuberant granulation tissue, located mainly in the myeloid part of the bone, formed as an attempt to repair previous bone destruction, due to trauma in the single lesions and in the multiple ones to some unknown cause. I believe the disease is one phase, or rather an exaggerated phase, of osteitis fibrosa cystica."

According to Martland, benign giant-cell sarcomas are always surrounded by a layer of bone and do not break through this bony shell. My own series contains several cases classed as giant-cell sarcoma or giant- and spindle-cell sarcoma, in which the bony capsule was entirely broken through and the neighboring joint invaded, with beginning infiltration of the soft parts. In these cases, the disease was of rapid growth, and in three cases had completely destroyed the knee-joint.

One of the best descriptions of the histological structure of these tumors may be found in the article on *Bone Sarcoma* by Ewing (Archives of Surgery, 1922, vol. iv, p. 496). He states:

> "The structure shows an abundance of giant cells with many small separate nuclei. They appear in masses or they surround capillaries or blood spaces. They are derived from the vascular endothelium but participate in the tumor process, sometimes extensively. The stroma is composed of many capillaries supported by a moderate number of spindle fibroblasts, with nuclei showing normal or slightly increased chromatin. Tumors of this type are always strictly benign, in the oncologic sense, although they may lead to serious clinical disturbances. They may be cured by curettage, by Röntgen-ray and radium, and some of them disappear spontaneously. They may become transformed into simple cysts. They are prone to become infected from curettage or exploratory incision, and a progressive cellulitis and osteomyelitis may develop. The wide cavities left after curettage may offer some surgical problems."
>
> Ewing further states: "I have never known these tumors to produce metastases, and I have been unable to find authentic records of such complication; but it seems quite possible that by curettage groups of viable cells could be dislodged from the tumor and pass into the blood-vessels."

As to the origin of the giant cells, pathologists differ widely. Adami believes them to be myeloplaxes, the view originally held by Nélaton, and that they differ from the foreign body giant cell in the even distribution of the nucleus throughout the cell body, and in the absence of the central degeneration of the cells; and further that they differ from the true tumor giant cells in that their nuclei are well formed. Mallory and Barrie believe them to be foreign body giant cells. Stewart of Leeds strongly opposes this view.

Before taking up the main subject of this paper, prognosis, we must be sure that we are dealing with the same condition; and that brings up the question: is it always possible to make the diagnosis? Bloodgood believes that he can always make the diagnosis by the microscopic examination; and Ewing is of the opinion that the diagnosis can nearly always be made by the clinical history, physical signs, and X-ray picture, without the exploratory operation, which he strongly condemns. Yet Ewing admits a group of "border-line cases of giant-cell tumors" which he describes as "some bone tumors mainly central in location and found to have involved much of the neighboring bone shaft which is eroded or perforated while the tumor tissue easily penetrates the soft tissue and fails to throw out a uniform limiting shell of bone. The structure consists of numerous large spindle cells. The cells may appear polyhedral; giant cells are scanty or absent in many areas, but appear in groups often in the clefts or sinuses of tumor tissue. They are not so large as the giant cells of the ordinary giant-cell tumor and the nuclei while multiple are larger and more hyperchromatic. The diagnostic difficulties are increased when only curetted fragments of the tumor are available. Such tumors are a difficult problem for the pathologist and the surgeon. My colleagues and I have adopted the policy of designating these tumors as border-line tumors of the giant-cell type, and giving a guarded prognosis. They are prone to recur after curettage; but I have never known them to produce metastases even after repeated insults." Ewing believes this group probably belongs to the benign giant-cell tumors. Platou, of Christiania, who made a histological study of nine cases of giant-cell sarcoma, while holding that the majority of these tumors are benign, admits the difficulty of making a positive diagnosis; and he concludes with this statement: "It is deplorable that a microscopic examination sometimes permits only of a probable diagnosis. There has not yet been discovered any test whereby the diagnosis may become absolutely certain either way when the cases are doubtful."

Nélaton, in his splendid monograph on *Tumeurs benignes des os ou tumeurs à myéloplaxes* (Paris, 1860), made the first serious attempt to differentiate the different types of bone tumors, with special reference to their malignancy. This report covers 364 pages, and is based on a study of 46 cases of giant-cell sarcoma, chiefly collected from the medical literature and hospital reports in France and in England, and includes only six cases representing personal observations. The monograph contains an excellent

series of drawings, showing both the macroscopical and microscopical appearances of the tumors in question.

Nélaton believed that the new kind of tumor which he describes was practically benign in character, and while often highly malignant locally, it never caused death by metastases, and was sufficiently different in gross and microscopical appearances to enable one to differentiate it from the more malignant types of bone sarcoma.

FIG. 5.—(Case No. 3 in text.) Benign giant-cell sarcoma of tibia; recurrence after repeated curettage and repeated radium treatment; amputation; recurrence; extension of disease in pelvis; death.

Nélaton was wrong in his belief that these tumors never metastasize, as was proven nineteen years later by Gross in his classical paper on *Sarcoma of the Long Bones*, in which he reported five cases of myeloid or giant-cell sarcoma associated with metastases of the lungs. Furthermore, at a symposium on Long-bone Sarcoma, before the Royal Society of Medicine, in 1912, two other cases associated with lung metastases were reported.

While Nélaton is an authority who is constantly being quoted in proof of the benign character of giant-cell sarcoma of the long bones, I doubt if many of the writers who quote him have read his book. An analysis of 46 cases forms the basis. This includes 15 cases of tumor of the upper jaw, 14 of the lower jaw and 2 of the dorsum of the foot. Tumors of the jaw of the giant-cell epulis type, for many years have been recognized as usually benign. There were *only 14 cases of tumors of the long bones* (4 of the femur, 6 of the tibia, 1 of the humerus, and 2 of the radius). Inasmuch as these were operated upon before the time of Lister's discoveries, it is not a matter of surprise that 4 or twenty-five per cent. of these cases died of infection following operation. The most striking point brought out is, that of the 14 cases treated by amputation, only 2 were well for 3 years (1 of the femur and 1 of the radius), 5 were traced for less than one year, and 4 were not traced at all. In other words, of the entire series treated by most radical surgical operation (amputation), only 2 cases were known to be well over three years. Hence we see at a glance how absolutely impossible it is to draw any

conclusions whatever as to the main question at issue, namely, the benign or malignant character of these 14 tumors. Had they all been highly malignant central sarcomas, we could reasonably expect 2 to have been cured by amputation. Bloodgood has stated that 10 per cent. of malignant central sarcomata are cured by amputation.

As we have stated, only 6 of the 46 cases were personal observations, the remainder having been collected from the medical literature. Many of these case-reports were lacking in essential data; yet the most serious difficulty found in Nélaton's statistics—as far as their value in estimating the malignancy of tumors—is the fact that the end-results in these cases are almost entirely lacking. In reviewing his report of 29 jaw tumors of the epulis type, we find only 2 of the 15 cases of the upper jaw, well over three years, and 4 of the 14 cases of the lower jaw well over three years; 3 died of infection; 6 were traced for less than one year, and the remainder were not traced at all.

FIG. 6.—(Case No. 3 in text.)

In addition, Nélaton reports in full detail, two other cases, one involving the sternum, clavicle, scapula, ribs, and later the spine, in which the disease progressed rapidly, causing death within a few months; he regards these lesions as multiple primary tumors rather than metastases, but from the clinical history and our later knowledge, it is very probable that he was dealing with either a metastasizing giant-cell sarcoma or a multiple myeloma, a highly malignant type of tumor. The other case involved the sacrum and lower dorsal spine, causing death in a comparatively short time. It is hard to see how these cases could be fairly included in a group of benign tumors of the bone when the disease killed the patient from multiple tumors, although, without causing metastases in the lung.

Whatever may be the final decision as to the benign or malignant nature of giant-cell sarcoma of the long bones, it is quite evident that the question was not settled by Nélaton and that it must rest upon a careful follow-up of the end-results of a large number of more recent cases.

If we take another series of 93 consecutive cases of long-bone sarcoma

observed by Van Brun's Clinic, from 1860 to 1903, reported by O. Kocher (Beit. z. Klin. Chir., 1906, Bd. 50 Hft. 1, p. 118), we find 28 cases ruled out on account of defective histories; of the remainder, 32 were classified as periosteal, and 33 as myelogenous, the old term for giant-cell sarcoma. Unless the condition is comparatively rare, there must have been some so-called benign giant-cell sarcomas at this large clinic during a period of forty-three years, and if there were, they must be found in this group of 33 myeloid sarcomas. A study of the end-results of this group is, therefore, of great interest; 24 cases were treated by amputation, 7 by exarticulation; 4 died of the operation, leaving 20 cases; of these:

15 were traced,
13 died of metastases,
2 living and well (15 and 20 years, respectively).

Of the 4 cases treated by resection:

1 died of operation,
1 died of metastases,
2 living and well (17 and 27 years, respectively).

Thus of the 33 cases of myeloid sarcoma, only 4 are known to have been alive more than three years. One must conclude that there could have been few benign giant-cell tumors in this group, for if there had been, they must certainly have been cured by such a radical operation as amputation.

The profession is deeply indebted to Bloodgood, for being one of the first to attempt a scientific study of the important question of the relative malignancy of giant-cell tumors; and by his painstaking effort, he has established the fact that the great majority of these tumors are only locally malignant. His work has had a marked and increasing influence on the surgical treatment of giant-cell tumors. While in Bloodgood's earlier series of 18 cases (ANNALS OF SURGERY, 1910), only one out of eight cases of giant-cell sarcoma of the radius was treated by curettage, the rest by amputation or resection, he states that in the light of his present knowledge he would, probably, treat all of these cases by curettage. In my own series of 8 cases of giant-cell sarcoma of the radius, amputation was not performed in a single case. Personally, I have long been a believer in the conservative treatment of sarcoma of the long bones, especially of the central group, and in a monograph on the subject, published in 1910 (Journal A. M. A., vol. liv, p. 333), I made the following statement:

> "Coming to sarcoma of the tibia, fibula, and radius and ulna, particularly of the myeloid type, in place of amputation as formerly advised and still advocated by the great majority of surgeons, we can safely substitute either curetting or partial resection, followed by a thorough course of the mixed toxins. While good results have been obtained from operation alone in a very limited number of cases in this group, I am convinced that the number of successes will be greatly increased by combining the toxin treatment with conservative operations, as I have suggested, and my series of cases strongly supports this opinion."
>
> In 1905, I treated an extensive giant-cell sarcoma involving the lower third of the tibia, by repeated curettage followed by prolonged toxins and X-ray. The leg

was saved, and I showed the patient before the New York Surgical Society on November 14, 1923, eighteen years later, in good health and with complete restoration of function.

The only point on which I differ from Bloodgood is, that while he believes that all giant-cell tumors are benign and only locally malignant, I believe that a certain number are definitely malignant and cause death by metastases, and that it is not always possible to differentiate the benign from the malignant especially in the early stages of the disease.

According to Bloodgood, exploratory incision and curettage do not increase the malignancy of the local growth of the giant-cell tumor; and he believes this fact to be of great importance in justifying the less radical procedures; with this opinion, I am in complete accord.

In his original article, published in 1910, Bloodgood reported 18 cases, all of which had remained well. It should be noted that fifty per cent. of these giant-cell tumors occurred in the lower end of the radius; only one (of this group) was treated by curettage, and the remainder by amputation. In the entire 18 cases, only 6 were treated by curettage, 4 by resection, and the remainder by amputation. In other words, in 1910, amputation or resection was the method of choice and curettage was only rarely employed. In Bloodgood's later series of cases published in 1919, in 10 femur cases, resection was employed in only one case; and the others were treated by amputation. In his later paper, Bloodgood calls attention to the case of Dr. Frank Hinds: a rather extensive giant-cell sarcoma of the lower end of the femur, treated by curettage plus zinc chloride; the patient completely recovered and was in good health twenty-one years later. This case, I believe, is the only one in literature in any way parallel to the two cases of sarcoma of the femur which I have reported, one well nine years, and the other, seven years; in which, any less radical operation than amputation was employed. The only point of difference is that in Hind's case, the joint was not involved, whereas in my two cases, there was extensive involvement of the knee-joint.

Bloodgood, in his latest paper on The Conservative Treatment of Giant-cell Sarcoma (American Journal of Surgery, May, 1923) gives the result of treatment in 77 cases of giant-cell tumors personally observed or of which he has record, since 1899. It is interesting to note the methods of treatment employed: curettage in 42 cases, resection in 23 cases, and amputation in 12 cases. In the earliest series, in 1899, one case was treated by curettage, none by resection, and 4 by amputation; in a series treated in 1909, 0 cases were treated by curettage, 3 by resection, and 4 by amputation; and in the 1920 series, 14 cases were treated by curettage, 3 by resection, and 2 by amputation; in other words, there has been a slow and steady movement to substitute conservative treatment for amputation which was almost universally employed in the earlier years.

Bloodgood's series of 77 cases, apparently, showed no mortality; in the 42 cases treated by curettage, 26 were apparently cured by the primary opera-

tion, and 16 showed recurrence; of these 16 recurrences, 6 were treated by resection, and 4 by amputation.

Bloodgood asks the question, why so many surgeons still treat central giant-cell tumors of the long bones by amputation; and he answers this question in the following way: "Because in the majority of cases, their pathologist colleagues looked upon the tumor as malignant and called it sar-

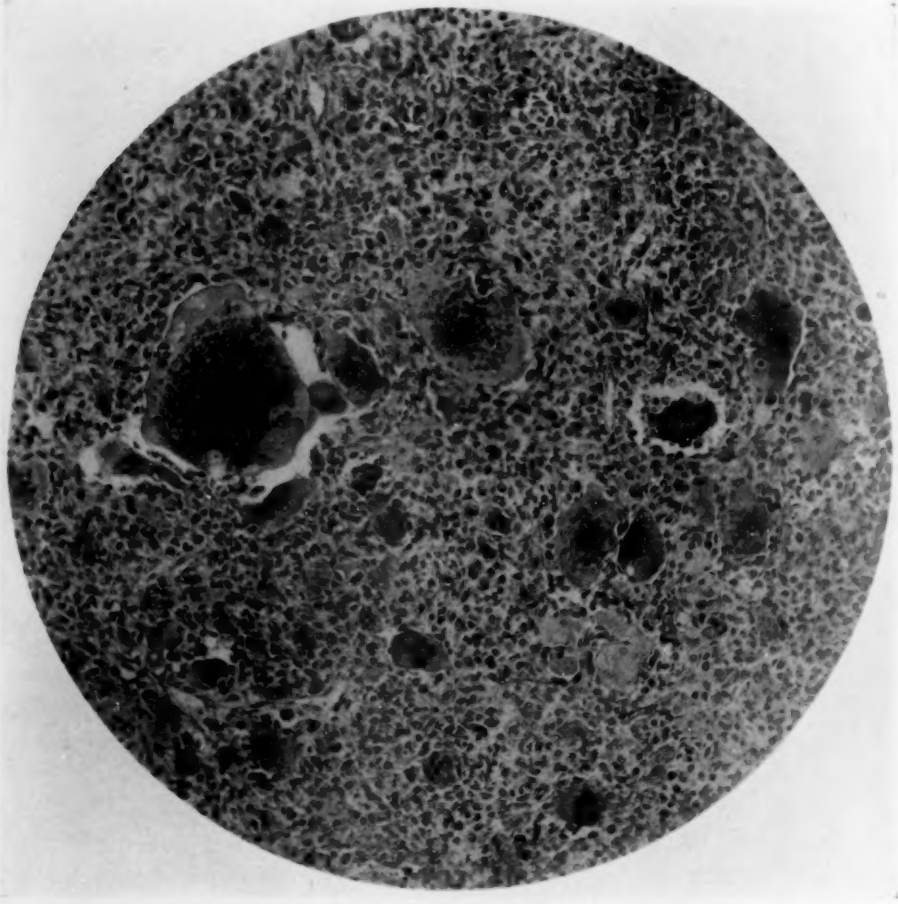

FIG. 7.—(Case No. 3 in text.)

coma; and because they have always been able to give an example of tumors which they claimed to be identical and which caused the death of the patients from metastases to the lungs, and when the cases came to autopsy, they found giant cells in the metastatic tumors." He then cites a case in point, *i.e.*, amputation for a central tumor of the tibia by Codman in 1910; pronounced giant-cell sarcoma by Wright (Pathologist to the Massachusetts General Hospital); the patient died of metastases one year later. He adds, that on subsequently reviewing the microscopic slide of this case, "we agreed that it was a malignant and not a benign giant-cell one."

Here lies the crux of the problem: is it always possible for any considerable number of experienced pathologists to differentiate a benign from a malignant giant-cell tumor at the time of the primary exploratory operation or curettage? It is probably true that Bloodgood, who has made a special study of these cases for more than twenty years, may be able to make the diagnosis in the great majority of cases; but even he is not able

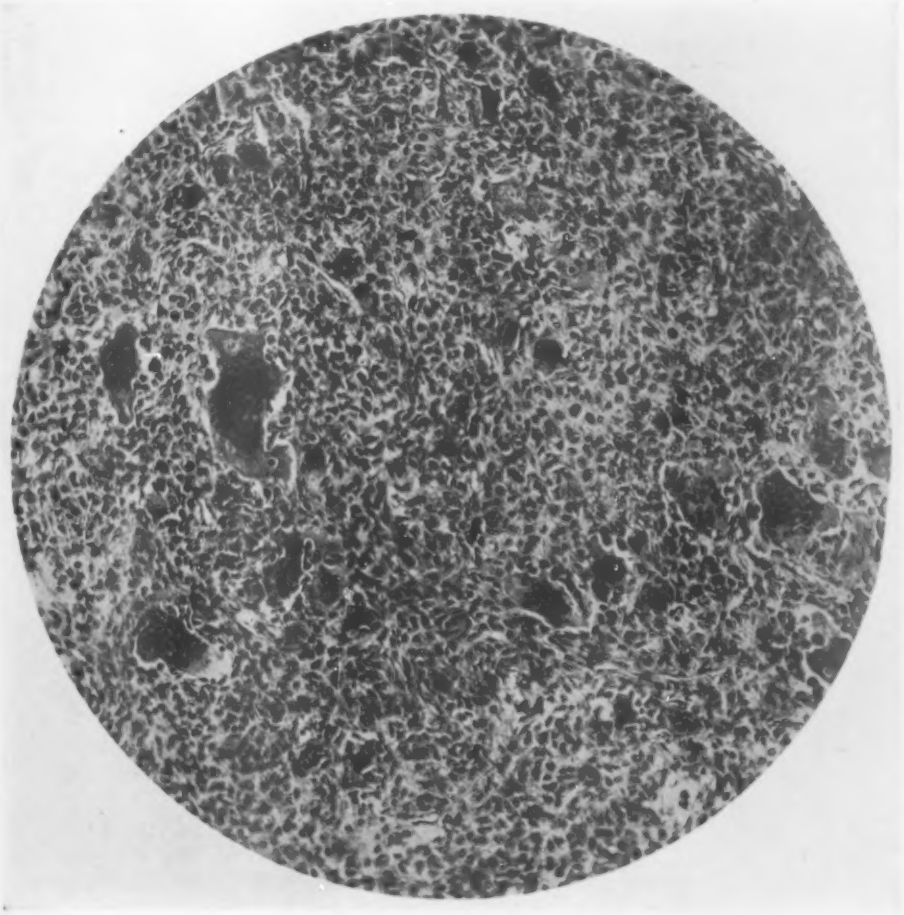

FIG. 8.—(Case No. 3 in text.)

to do so in every case; and I believe that there is a considerable number of cases in which the average pathologist still finds it difficult or impossible to differentiate the benign from the malignant type.

It is quite a different matter to make the diagnosis at the time of operation, from making a diagnosis after the end result is known and the patient has died of metastasis or is alive ten years after operation.

The paper on *Observations on Myeloid Sarcoma, with an Analysis of 50 cases,* by (Dr. Matthew J.) Stewart, Pathologist to the Leeds General

Infirmary and now Professor of Pathology, Medical Department, University of Leeds (*Lancet*, November 28, 1914), represents one of the most important studies of the subject. After summarizing the current views on myeloid sarcoma, the author gives an analysis of fifty cases observed at the Leeds General Infirmary during a period of fourteen years. In every one of these cases, the diagnosis was confirmed by microscopical examination of the tumor, and in forty-five cases, the pathologist's report was verified by Stewart.

FIG. 9.—(Case No. 4 in text.) November, 1923.

It is important to note that in thirty-five of the fifty cases, the site of the disease was the jaws, which tumors have long been recognized as practically benign; and in only eleven cases did the disease occur in the long bones, and in four cases in other localities. Confining ourselves to the long bones, in which we are particularly interested, we note that in six cases the disease occurred in the femur, in four cases in the lower end, and in two in the upper; in three cases it occurred in the humerus, in two in the lower end, and in one in the upper; in one case, it occurred in the upper end of the tibia and in one case in the upper end of the radius. As Stewart points out, these facts furnish a striking contrast to Bland-Sutton's view that the tibia is the favorite site of the disease in the lower limb, and the radius, in the upper. To the eleven long bone cases of his own series, Stewart has added ten long bone cases collected by Gask from the St. Bartholomew's Hospital records, covering a period from 1902 to 1911, and twelve other cases collected by Maybury from the St. Thomas' Hospital records, covering a period from 1901 to 1911, making a total of thirty-three long bone cases. In all of these, the diagnosis was confirmed by microscopical examination. The locality is shown as follows:

Femur, 19 (17 lower end and 2 upper end). Tibia, 5 (all upper end). Humerus, 4 (2 upper end and 2 lower end). Radius, 4 (3 lower end and 1 upper end). Fibula, 1 (upper end). Total, 33.

In other words, in more than half of the number of cases, the disease occurred in the lower end of the femur. In my series of 50 cases, 22 occurred in the femur; 19 in the lower end and 3 in the upper end. In striking contrast to this is

Bloodgood's series of 18 cases, in which, in ten cases, the disease occurred in the lower end of the radius.

As regards the age in Stewart's series, the youngest patient was twenty-one years old, and the oldest, fifty-one years.

In analyzing fifteen cases of his own series, exclusive of the jaw, Stewart states that, of eleven cases which it was possible to trace, nine are living, one has had a recurrence, and one died. The latter case was a man with a myeloid sarcoma of the upper end of the femur; diagnosis established by exploratory operation; operation advised but refused; the patient lived for five years, the growth ultimately fungating in several places; but there was no clinical evidence of metastases. Seven of these cases were treated by local removal of the growth, and seven by immediate amputation; of the latter, only four cases were traced, all of which were alive and well. Of the seven cases treated by local removal, three have remained well, and in three, the diseases recurred; of the latter, one was treated by local removal, one by amputation, and the third had a recurrence at the time of writing.

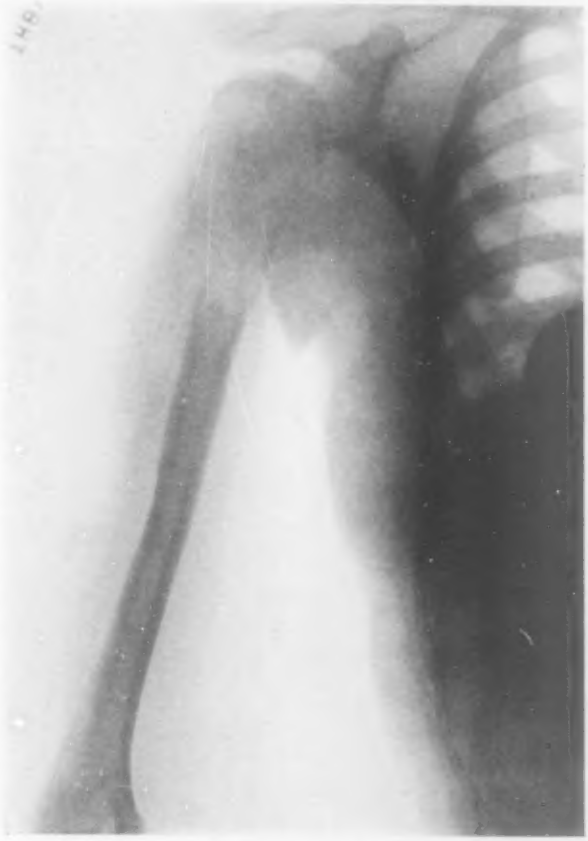

FIG. 10.—(Case No. 4 in text.) May, 1923. Benign giant-cell sarcoma of humerus; developed metastases in radius and extension of disease in pectoral region; condition hopeless.

Taking Stewart's cases as a whole, including the thirty-five jaw cases, of forty cases in which it was possible to trace the end result, thirty-eight were alive at the time of writing, thirty-one having remained well over three years. In the two cases that died, one had a fungating tumor of the thigh, and the other developed an independent infection. There was no evidence of dissemination in any case.

In collecting this material, Stewart found five cases of what he describes as examples of *malignant giant-cell sarcoma*, to which he has added a sixth case seen in private practice. Four of these were long bone cases; all were treated by amputation; and all died from six months to three years later of lung metastasis. In only one case was an autopsy made. These cases show the importance of being able to differentiate the benign giant-cell tumor from the malignant giant cells, which is usually of a very high degree of malignancy. This, Stewart believes it is possible to do. He states, "The histological diagnosis is based on the morpho-

logical characters of the giant cells, especially as regards their nuclei. In myeloid sarcoma the latter are numerous, uniform, small, and without mitoses; in malignant giant-cell sarcoma they are few, sometimes single, irregular, and often very large, while mitotic figures are frequent."

It would be interesting to know whether the malignant features of these six

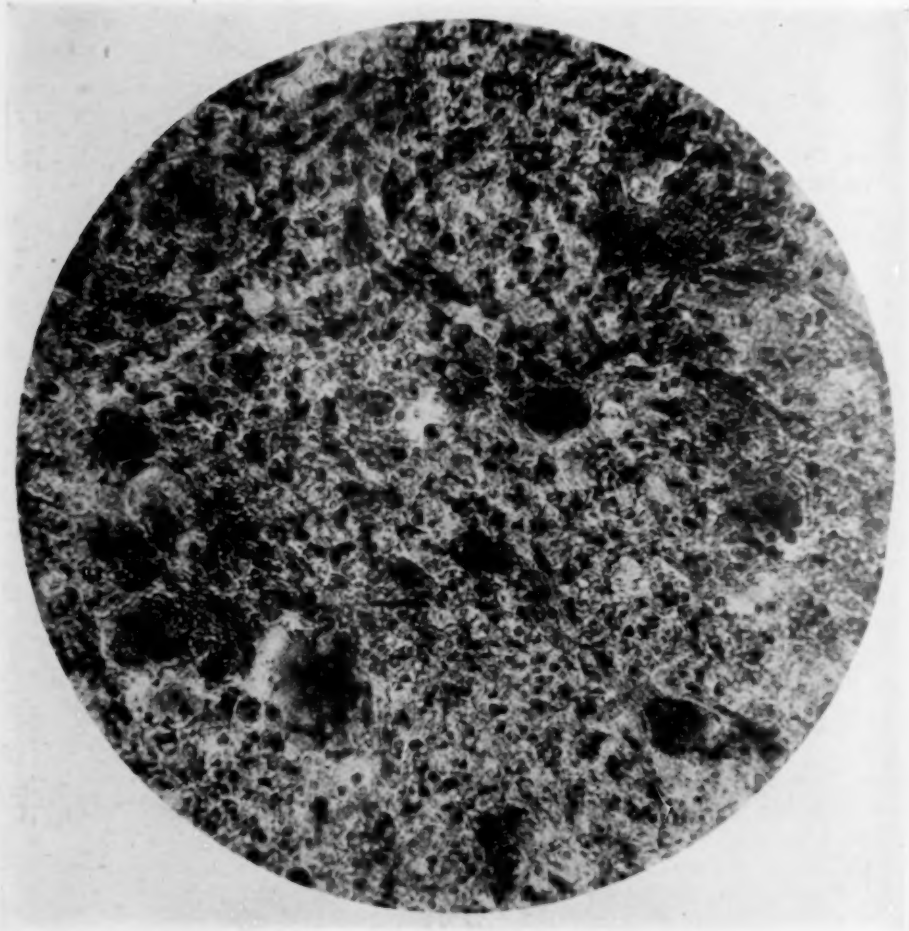

FIG. 11.—(Case No. 4 in text.)

cases were recognized at the time of operation or not until the end result was known.

In a later paper on *The Histogenesis of Myeloid Sarcoma* (*Lancet*, November 25, 1922), Stewart gives us the results of another careful study of the subject, based upon nine years of added experience. He states, "Myeloid sarcoma (myeloma, sarcome à myéloplaxes) is one of the best recognized and most sharply defined of clinical and pathological entities. Its anatomical characters, both gross and microscopic, are, in the great majority of instances, clean-cut and unmistakable, and at the present time there is almost complete unanimity of opinion as to the clinical behavior and appropriate treatment of the lesion." Maintaining that these tumors are only locally malignant, Stewart disagrees with Bloodgood, who takes them out of the group of sarcoma, and classifies them as benign giant-cell tumor;

and also with Barrie, who characterizes them as a type of hemorrhagic osteomyelitis. Stewart believes that the name "myeloid sarcoma," as introduced by Paget nearly seventy years ago, on account of the naked-eye resemblance of the tumor to red marrow, is the best name to apply to this group of tumors; and that since none of its constituent cells is derived from specific bone-marrow cells, the name "myeloma" is inaccurate and should be dropped. While Stewart still adheres to his original opinion that "myeloid sarcoma" is only locally malignant, he states

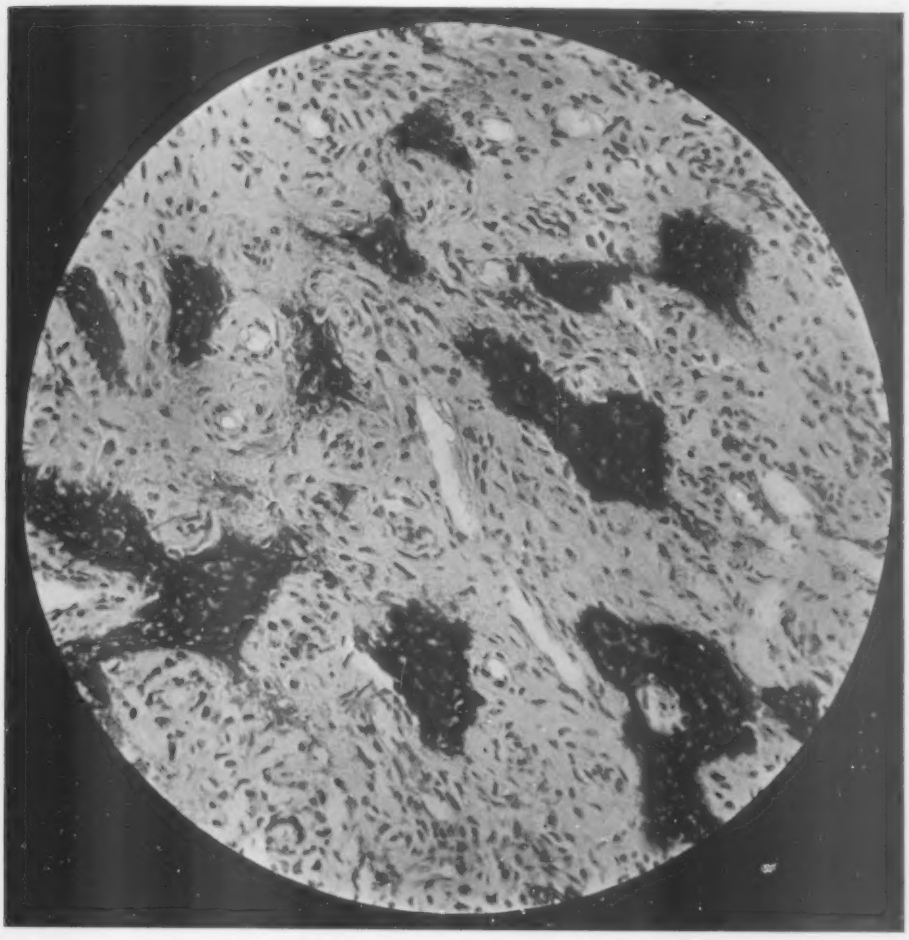

FIG. 12.—(Case No. 7 in text.) Sarcoma of humerus, giant- and spindle-cell of epulis type. Amputation; local recurrence probable lung metastases; death 3 months later.

that in the discussion that followed his communication, Dr. Archibald Leitch mentioned that he had seen a genuine case of myeloid sarcoma with metastases. The structures of the secondary deposits was similar to that of the primary growth, and included typical, osteoclast-like giant cells. This case, he believes, affords strong confirmation of some of the views expressed in this paper, notably (1) that the tumor is essentially a sarcoma, albeit of only local malignancy in the great majority of cases, and (2) that the giant cells are not fortuitous but a constant and integral part of the growth.

OCCURRENCE OF METASTASES IN CASES OF GIANT-CELL SARCOMA OBSERVED BY OTHER SURGEONS

Gross, in his well-known monograph on *Sarcoma of the Long Bones*, published in 1879, took issue with the position held by Nélaton, that these cases of giant-cell sarcoma were always benign; and he reported five cases from the literature, in which metastases had occurred.

FIG. 13.—(Case No. 12, in text.) Benign giant-cell sarcoma of radius, treated by curettage and carbolic acid; recurrence; toxin treatment; disappearance; recurrence; radium treatment steady increase in size; toxin treatment; improvement; recovery. Picture taken in November, 1919, before treatment.

Auge and Roux (Bull. de l'association franc. pour l'etude du cancer, 1922, 11, 616) report a case of giant-cell tumor of the femur; amputation; recurrence; generalization in two months. This tumor was supposed to be a myeloid sarcoma of the lower end of the femur. The patient, a man of twenty-two years, gave a history of having had pain for two months, following a fall, and a swelling which was noticeable only ten days before admission to the hospital. X-ray examination showed a slight, fusiform, epicondylar swelling of the bone, the continuity of which was intact. The patient was pale, emaciated and febrile. A clinical diagnosis of osteomyelitis was made. A spontaneous fracture developed about one week later. A sub-trochanteric amputation was performed without preliminary exploratory operation. Histological diagnosis: "tumeur à myéloplaxes" (Nélaton's term for a giant-cell sarcoma); and a benign prognosis was made. The wound healed by primary union. At the end of two months, the patient had an attack of what was thought to be pulmonary influenza. On re-admission, a recurrent nodule was found in the amputation scar, and there were definite symptoms of pulmonary metastases; death occurred one week later. Fortunately, a post-mortem examination was made; the lung was found to contain numerous hemorrhagic nodules or growths, together with commencing pericardial involvement; the left kidney was almost completely replaced by tumor. Microscopical examination of the primary tumor showed very many typical multinucleated giant cells, including many enormous forms with innumerable nuclei; these seemed to be most abundant where there was necrosis and hemorrhage, and occurred chiefly in the central part of the tumor. The mixed cell ground-work was composed of cells which showed great variety both in size and shape; there were many mitotic figures. Nearly all of the nodules from the lungs and the secondary deposits in the kidneys showed numerous multinucleated giant cells (one tiny nodule in the lung showed no giant cells). The authors conclude that the mere presence of giant cells in this type of tumor of the long bones, does not necessarily carry with it the benign prognosis of a "tumeur à myéloplaxes." If this term is used, it must

be kept in mind that forms exist where clinical malignancy shows itself by generalization, and where the giant cells have a diversity of form and are of atypical character.

Stewart (to whom I am indebted for a very complete abstract of the case), in a careful review of it, states: "In so far as it is possible to judge from a careful description and four excellent drawings, I am of the opinion that the case here described is one of myeloid sarcoma (myeloma, temeur à myéloplaxes), but one in which anaplasia is unusually well marked. The giant cells are of osteoclastic type, and are in profusion in both the primary and secondary growths. They are quite as numerous as in most myeloid sarcomas. Their complete absence from one tiny nodule in the lung can be explained on an anaplastic hypothesis, none of the young, very actively-growing cells having as yet differentiated into osteoclasts. * * * The practical conclusion is that there occur cases, clinically and pathologically indistinguishable from ordinary myeloid sarcoma, in which an unusually high grade of malignancy exists, including even the power of dissemination. Such cases are obviously of rare occurrence, but the possibility should be borne in mind by surgeons."

FIG. 14.—(Case No. 12 in text.) October, 1920, after four months' radium treatment.

Oertel (Professor of Pathology, McGill University), at a meeting of the Interurban Orthopædic Society in Montreal a year ago, reported a case of giant-cell sarcoma of the femur, in which death occurred from metastases. Doctor Oertel has very kindly sent me a few notes of this case with photographs of the gross and microscopic specimens. This patient, a man of forty-one years, was amputated for what, on histological examination, proved to be a typical giant-cell tumor of the epulis type of the lower epiphysis of the femur. The leg was primarily amputated, not only for the tumor, but for a suspected thrombosis of the femoral vein. However, the amputated leg itself did not show, and did not include, the thrombosed part; this was found later, at autopsy, higher up; it was in this connection that a metastases of the growth in the wall of the vessel was found, a considerable distance above the original growth. According to Oertel, it was probably this lesion of the vessel wall which gave rise to formation of a thrombus in this situation and from this, subsequent thrombus extension into the vena cava inferior and terminal pulmonary artery embolism took place. About the metastatic nature of the growth in the vessel wall, Oertel believes there can be no doubt. It was distinctly nodular and definitely inserted into the vessel wall, so that it could be readily differentiated, and separated from the organizing thrombus in the lumen. The histological picture also is in exact conformity with the primary growth, although the cell contents are here somewhat more embryonic than in the original. The accompanying giant cells in the metastasis were numerous, as in the primary growth, and quite typical in appearance. No other metastases were found, and the termination through pulmonary embolus ended life abruptly.

Oertel concludes that this case is another example of how careful one must be in making prognoses from histological sections alone. While he agrees with those who regard the epulis type of tumor, generally speaking, as local lesions, he believes it should always be borne in mind that they are, after all, very unbalanced embryonic tissues and that they may give rise, when, as in this instance, they break into veins, to tumor extension and possible metastases.

NOTE: This case has been published in full detail in the ANNALS OF SURGERY, December, 1923, by Doctors Waugh and Turner.

Shattock, Professor of Pathology, St. Thomas' Hospital, Medical School and Curator of the Museum of the Royal College of Surgeons in his *Pathological Remarks on Sarcoma of the Long Bones* (The British Journal of Surgery, 1923, vol. xi, p. 127), states: "Some of the giant-cell tumors of bone are distinctly malignant and produce metastasis —a fact fully recognized by Sir Henry Butlin."

FIG. 15.—(Case No. 12 in text.) October, 1920.

Morton of the Yale Medical School, in an admirable article on *Generalized Types of Osteitis Fibrosa Cystica*, *Archives of Surgery*, 1922, has tabulated all the cases of this rare disease that he could find in literature, and he divides them into two groups: (1) without giant-cell sarcoma, (2) with giant-cell sarcoma. Of the first group, containing 36 cases, 12, or thirty-three per cent., died; of the second group, containing 26 cases, 15, or fifty-eight per cent., died. In other words, in the group the cases in which there was a pathological diagnosis of giant-cell sarcoma, the mortality was nearly double that in which no giant-cell sarcoma was found. It would seem possible that we were dealing with multiple or metastasizing giant-cell sarcoma in the one group instead of the ordinary Van Recklinghausen disease, osteitis fibrosa cystica.

In spite of this group of cases, Morton is of the firm belief that giant-cell sarcomas are benign, and he adds that there is abundant histological and clinical evidence at hand now to firmly establish the benignity of these giant-cell growths; furthermore, that they grow locally only, do not metastasize, recur only on incomplete removal and may be removed by local operation several times if necessary.

Gibbon, of Charlotte, N. C. (Journal of Bone and Joint Surgery, July, 1922, p. 512), reported a case of sarcoma of the femur in a boy, sixteen years of age, in which the clinical and X-ray diagnosis was giant-cell sarcoma. The case was first treated by curettage. The gross specimen closely resembled giant-cell sarcoma. A specimen of the tumor was sent to Bloodgood, and another portion to Crawford, of Philadelphia. Bloodgood stated in his report: "Your description

of the gross tumor is that of a giant-cell tumor; but there is a sarcoma, fortunately rare, which resembles much a giant-cell tumor in the gross; and I fear that your tumor belongs to the sarcoma group." Doctor Crawford reported: "giant-cell sarcoma." The tumor recurred before the reports of the pathologists had been received by Gibbon, and grew rapidly in size so that it was necessary to perform an immediate amputation. While the patient was in good health at the time of his report, a personal communication from Gibbon, in May, 1923, stated that the boy had died in less than a year after the amputation of metastases in the lungs.

Morton and Duffy, of the Department of Surgery of the Yale University Medical School, have recently published an admirable article on Bone Sarcoma (*Archives of Surgery*, November, 1923). Although the paper is based upon a study of only ten cases, these cases are published with such complete, clinical, X-ray and pathologic data, that, what they lack in quantity is more than made up for in quality. Some of their observations and conclusions are so well thought out and so practical that they are worthy of brief note:

"We are impressed with the difficulties which confront the average surgeon in arriving at a correct diagnosis and in deciding on a proper treatment in any group of bone tumors. There are so many exceptions to the rule, that each case must be most completely studied and weighed before action is taken. Were we to trust to the Röntgen-ray picture for the diagnosis we would in many instances be wrong. Were we to depend upon the microscopic sections alone, especially at the time of operation, we would be often misled."

Case No. 8 of their series is of special interest inasmuch as it was a giant-cell tumor in which it was extremely difficult to decide either for or against malignancy, much of the evidence, both from the gross appearance and the microscopic sections, being uncertain and conflicting. From a study of this case, they conclude:

"Therefore, it would seem that in a definite group of giant-cell tumors, malignancy must be recognized, in which the clinical features and Röntgen-ray findings must have great weight in determining the diagnosis." This shows that Morton's opinion has been somewhat modified by further experience.

I cannot agree with their conclusion that, when the tumor is of very rapid growth and had progressed extensively when first seen, that other measures such as X-ray or radium, at least until we get more information, would seem to meet the situation better than radical amputation of the part. It seems to me that the treatment of this group of cases furnishes, perhaps, the most difficult problem of all. The very fact that the tumor is of rapid growth, in my opinion, is a proof positive that it is of a high degree of malignancy. The only hope of saving the life of the patient in this group, I believe, lies in amputation at the earliest possible moment, following this with prophylactic treatment.

One of the most recent and practical discussions of the diagnosis of bone tumors is found in an editorial note following a review of Tumors of Bones, in the Twentieth Report of Progress in Orthopædic Surgery (*Archives of Surgery*, May, 1923, vol. vi, pp. 858–908) by Robert B. Osgood and collaborators.

"Differential diagnosis of bone tumors is far from certain by any known method, particularly röntgenoscopy. This is altogether natural when we remember that even with the gross specimen before him and the slide under the microscope, the pathologist is often uncertain as to its character. Often there is such widespread involvement of the bone that it is impossible to determine the point of origin or the invasion. While in sympathy with any effort to systematize the diagnosis, we are under the impression that the one point of importance is whether the growth is benign or malignant, and that the best way to determine this is by immediate exploration and pathologic examination. The relation of the region to be examined is also of importance, and occasionally the surgeon well trained in gross appearances in malignant disease must be governed by his finding quite as much as by the report of the pathologist, made necessarily somewhat incompletely at the time of operation."

FIG. 16.— (Case No. 12 in text.) January 29, 1921.

Treatment.—Exploratory operation. We very strongly disapprove of the present tendency to forego exploratory operation in tumors of the long bones, and believe that the disadvantages of exploratory operation have been unduly emphasized by the pathologists, thereby making the surgeons less and less inclined to avail themselves of this most important aid in diagnosis. The greatest objection to exploratory operation is the supposed danger of causing generalization of the disease from cutting into the tumor. That this danger is largely theoretical is shown by the fact that the great majority of cases of sarcoma of the bones that have been cured were cases in which exploratory operation had been performed. In these cases at least the operation did no harm. Furthermore, Wood has shown that biopsy in a large series of animal tumors has shown no greater percentage of metastases in cases in which an exploratory operation was performed than in cases in which this step was not taken. Another disadvantage claimed is the possibility of infection occurring in the exploratory incision. Infection in modern surgical technic should be a very rare occurrence. We have on two occasions curetted an extensive giant- and spindle-cell sarcoma of the lower end of the femur with involvement of the knee-joint, and kept it clean with Dakin's fluid until the wound had entirely healed, without infection; the patient was then given toxin- and radium-treatment, and is now living, with a useful limb, more than seven years later. Another similar case, with extensive knee-joint

involvement, treated with exploratory operation without curetting, followed by the use of the toxins alone, is well nine years later; this case was treated before the introduction of Dakin's fluid.

Without an exploratory operation, it is impossible to make an accurate diagnosis in a considerable number of cases; and unless an accurate diagnosis is made, the proper method of treatment cannot be employed sufficiently early to save the life or limb. In the giant-cell group of long-bone tumors, we would never do a simple exploration, removing a small portion of tumor for diagnostic purposes, but would perform a thorough curettage as soon as possible. I agree with Bloodgood that there is nothing to be gained by preliminary radium or X-ray treatment. Removal of all of the tumor by curettage gives the best chance of making a correct diagnosis from the microscopic section, and at the same time is the best method of treatment.

FIG. 17.—(Case No. 12 in text.) July, 1921.

There is at present no uniform method of treatment of giant-cell sarcoma. Immediate amputation, which was the routine method of treatment a decade ago, is seldom done at present. Curetting with the application of carbolic acid, the method advocated by Bloodgood in 1910, is probably, more largely used than any other method. Ewing, however, in his article on Bone Sarcoma in the *Archives of Surgery*, May, 1922, criticizes the standard method of treatment (curettage followed by some escarotic) on the ground that infections so frequently follow curettage, and lead to prolonged suppurative osteomyelitis and septicæmia; or the tumor recurs and requires repeated curettages with an advancing destruction of bone or opening into joints so that eventually amputation is required. He states that he "has observed many cases in which all of these unfortunate terminations have resulted in the hands of competent surgeons; nor is it unreasonable to assume that the trauma of repeated curettages may transform an originally benign process into one clinically malignant. Even the mechanical forcing of viable cells through open blood-vessels and the production of metastases, seem quite within the range of possible results of surgical trauma, especially so in cellular tumors." Ewing would give up curettage entirely and substitute routine treatment with X-ray and radium, by which, he states, all these hazards may be avoided. Ewing cites the results

of treatment of giant-cell sarcoma at the Memorial Hospital in support of his opinion.

Before giving up curettage and other conservative operations, for X-ray or radium alone, we should examine carefully (1) all the available data to determine, if possible, how frequently these untoward results that Ewing mentions occur in actual practice, and (2) the end results thus far obtained by radium and X-ray.

The statistics of Greenough, Simmons and Harmer, show 12 giant-cell sarcomas treated by operation, by curettage 7 cases, resection in 2 cases, amputa-

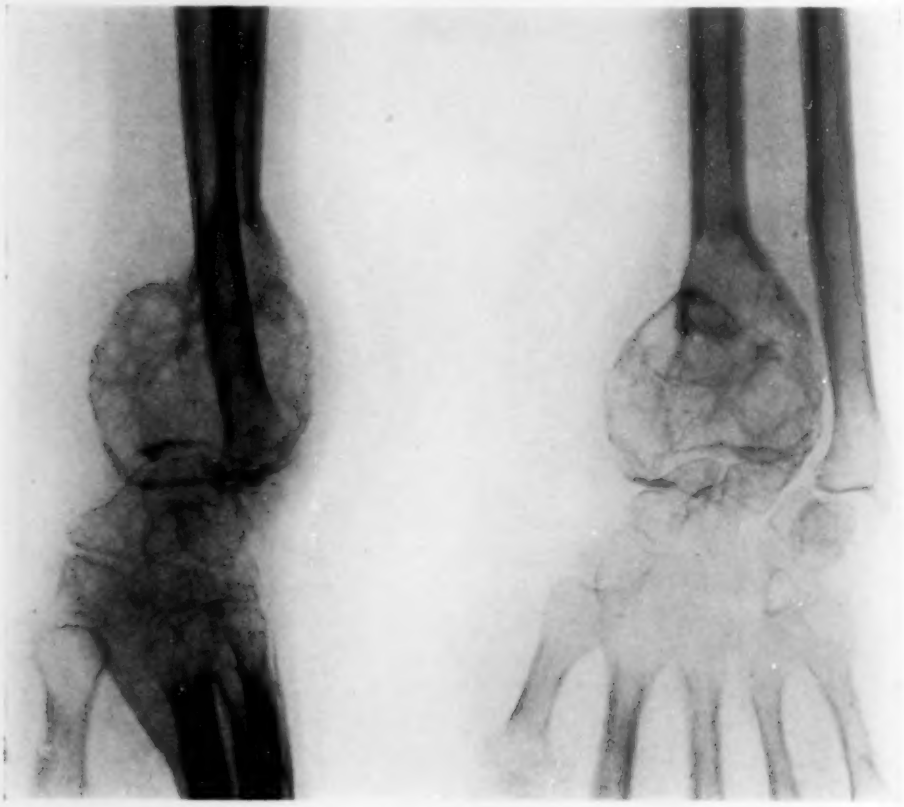

FIG. 18.— (Case No. 12 in text.) October, 1921; one year after toxin treatment.

tion in 3 cases, with only one death from operation in a very extensive case. Bloodgood, certainly, could not have found any large percentage of these bad results, or he would have called attention to the fact in his numerous publications. His latest series of cases show 46 treated by curettage with no deaths. An analysis of my own cases shows no case of osteomyelitis following curettage or exploratory operation, and no case of septicæmia. Delayed closure of the sinus with subsequent infection did, however, occur in 3 of our cases; in two of these, the exploratory operation and curetting had been done at other hospitals; and in one, bismuth paste had been

introduced into the cavity, which greatly delayed the wound healing and made amputation necessary a year later. In one case, a severe infection occurred a few weeks after operation, requiring amputation. In both of these cases, the condition was an extensive giant-cell sarcoma of the femur; and in both cases, amputation would have been advised by the majority of surgeons as the best primary method of treatment. Again both of these cases occurred before Dakin's fluid had come into use, which, probably, might have made amputation unnecessary. So that 3 out of nearly 50 cases would seem a very small proportion to justify the

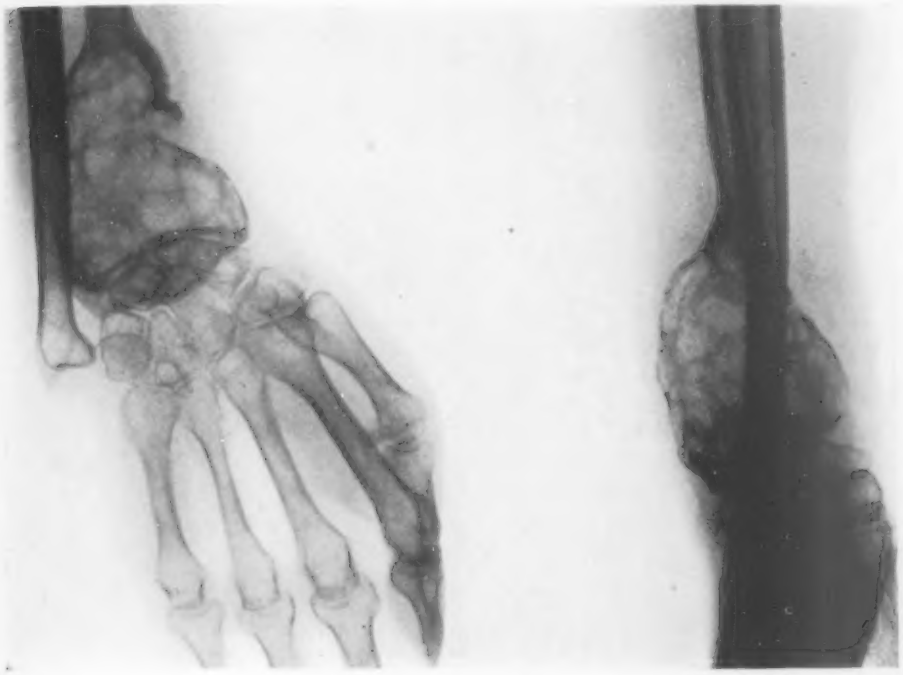

FIG. 19.— (Case No. 12 in text.) March, 1923.

surgeon in abandoning curettage or even exploratory operation to determine the nature of the tumor. Certainly, before giving up the surgical treatment of giant-cell sarcoma, we should first be in possession of some convincing evidence that X-ray or radium will cure not only an occasional case of giant-cell sarcoma, but as large a percentage as surgical methods. So far, we have no data to show the relative proportion of cases cured by radium or X-ray compared with those cured by curettage alone or curettage supplemented by radium or toxins. Ewing cites one case in literature and the Memorial Hospital results. So far at the Memorial Hospital we have had but two cases of giant-cell sarcoma in which the diagnosis was confirmed by microscopical examination in which the patient has been cured and remained well for a period of over three years. (1) A small endosteal tumor, a benign giant-cell sarcoma of the upper end of the tibia, in which one dose of radium

was given a short time after curettage is well more than 4 years; (2) a benign giant-cell sarcoma of the lower end of the femur, in which radium was used after curettage, and the treatment kept up for nearly one and a half years; this patient is well now three years later.† In both of these cases it should be noted that radium was not used alone but only subsequent to curettage and the appplication of carbolic acid. Another case, in which X-ray was used in a probable giant-cell sarcoma of the upper end of the humerus, remained well for a period of nearly two years, and was then lost sight of; in this case, however, there was no microscopical examination and the diagnosis rested

FIG. 20.—(Case No. 13 in text.) Giant- and spindle-cell sarcoma of femur with extensive involvement of entire knee-joint: exploratory incision; toxins; complete recovery; patient well 9 years later.

solely on the X-ray and clinical signs. In several other cases in which the diagnosis rested upon clinical and X-ray evidence, the tumors have been apparently controlled and the patients are well at present, but none of these cases has gone beyond the three-year period.

It is assumed that no bad results will follow the use of radium or X-ray in the treatment of long-bone sarcoma; and yet there is good reason to believe that if we could get a careful follow-up of all the cases treated by X-ray or radium, we should find untoward results quite as serious as those that have been observed following curettage. Only recently we have had to perform amputation of the thigh in the case of a benign giant-cell sarcoma of the lower end of the femur in an adult, who had originally been treated at another hospital by X-ray after curettage and carbolic acid had been applied;

† This patient has just suffered from a fracture of the femur just above the original site of the tumor from a fall.

in October, 1921, he had six X-ray treatments; he was admitted to the Memorial Hospital in December, 1921, and had one radium treatment at that time; a second one was given in March, 1922, and a third, in October, 1922 (total of 71,895 mc. hours). In the early part of 1923, a small ulcerated area developed just above the condyle, which slowly increased in size, and was accompanied by very severe pain. During the last eight months, there has been a gradual atrophy of the soft parts above the knee, accompanied by progressive fibrosis; the pain has steadily increased in severity, requiring large doses of sedatives; amputation was performed in October, 1923. Examination of the femur after removal showed that the sarcoma had been entirely cured, and replaced by a small cyst. The amount of radium used in this case was less than one-half that used in other long-bone cases without harm.

FIG. 21.—(Case No. 13 in text.) Showing nature's attempt to form a new condyle.

Bancroft (Clinics of North America, December, 1921, p. 1747) reported a case of giant-cell sarcoma of the lower end of the radius, in which osteomyelitis developed following X-ray and radium treatment; 100 mg. of radium were implanted in the cavity for five hours, after the second curettage on April 3, 1918. The cavity was then filled with bone wax; X-ray was used following the radium treatment. A severe X-ray burn occurred and the hand had to be kept in extension for several months. The condition was such that amputation was advised, at another hospital, but the patient refused. In December, 1919, one and one-half inches of the lower end of the radius and ulna were resected. During this period, the hand was practically useless. On May 2, 1921, a fourth operation was done, following which, the patient's condition was considerably improved, and she was able to perform her ordinary work without pain.

Although the theoretical discussion of the question of whether giant-cell sarcomas are benign or malignant is most interesting, the practical side of the the question is of far greater importance. The surgeon has charge of a patient who is suffering from a central tumor of the bone. A careful clinical

history, followed by a thorough physical examination will, in many cases, enable him to make an accurate diagnosis. This should always be supplemented by an X-ray picture, which will usually furnish additional aid of great value. In many cases, however, an accurate diagnosis cannot be posi-

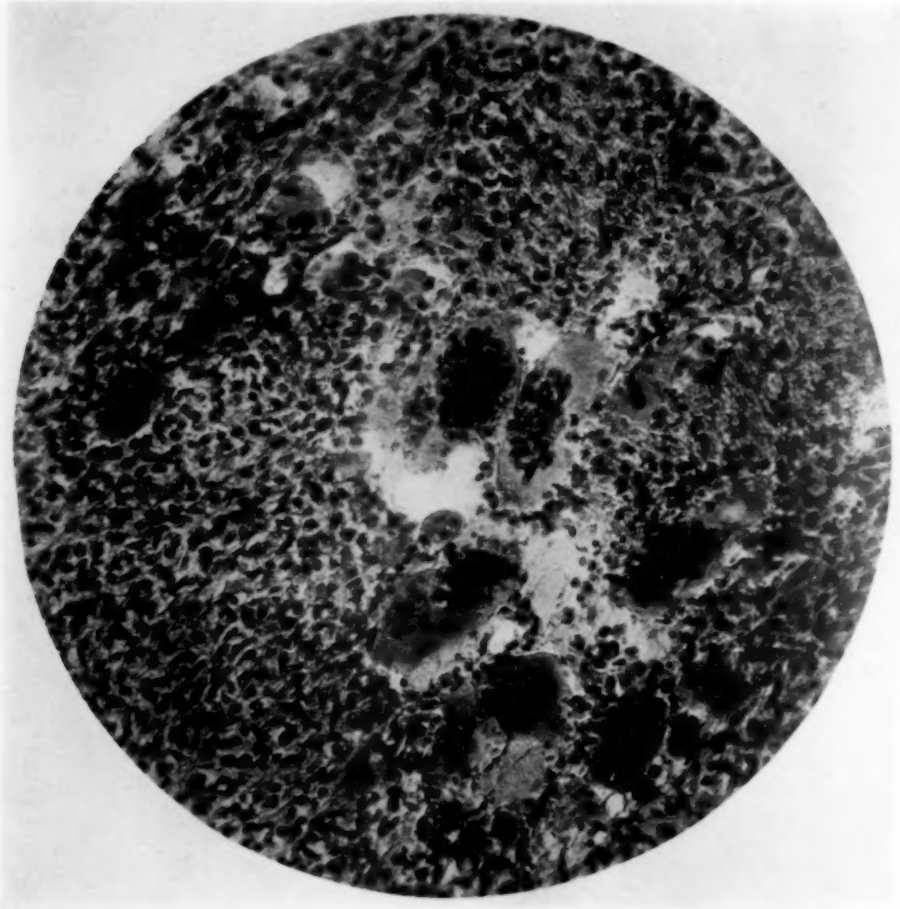

FIG. 22.—(Case No. 13 in text.)

tively made without a microscopical examination by a competent pathologist, and in a few cases not always with a microscopical examination.

If we are dealing with a small endosteal tumor of slow growth, with an X-ray picture typical of a giant-cell sarcoma, and a microscopical examination likewise showing the characteristic structures of this tumor, simple curetting followed by the application of carbolic acid, may be sufficient to cure the disease. Bloodgood has demonstrated that in many instances a cure can be effected by this method. Simple curetting, however, is often followed by a recurrence of the tumor, as Nélaton has pointed out in his monograph; and he recommended, in addition, the application of strong

solution of zinc chloride. I have seen a number of cases in which curetting and carbolic acid had little effect, and the operation was followed by rapid local recurrence and Stewart's cases show the marked tendency to recurrences after curettage. In advanced cases, resection has been employed with implantation of bone graft. In my experience, in far advanced cases, the disease can be often entirely eradicated by curetting followed by the use of the mixed toxins of erysipelas and bacillus prodigiosus alone, or combined with X-ray or radium; and in these cases the regeneration of bone has been sufficient to restore the normal function of the limb without the introduction of bone grafts. In a number of cases the disease has entirely disappeared under systemic injections of the mixed toxins alone, and in several cases it has disappeared under radium following curettage; so that we have several methods of controlling giant-cell sarcoma before resorting to amputation. In my series of cases, amputation was performed nineteen times; in only ten cases as a primary measure, and in nine cases, after failure to control the disease by conservative methods of treatment.

FIG. 23.—(Case No. 14 in text.) Giant- and spindle-cell sarcoma of femur which had broken through the bony shell, involving the soft parts; extensive invasion of the knee-joint and upper end of the tibia. Treated by curettage, toxins and radium.

There are at present at the Memorial Hospital a number of cases of giant-cell sarcoma under treatment by X-ray and radium. Most of these cases are showing improvement. There has been no exploratory operation done in these cases, and therefore, no microscopical examination has been made, the diagnosis resting entirely upon the clinical and X-ray evidence. The gradual replacement of the destroyed portions of bone by calcium salts has been regarded as a favorable X-ray or radium reaction. In none of these cases, however, has the tumor disappeared and the patient remained well for a sufficient length of time to justify one in regarding him as cured. Therefore, in our opinion, at the present time we have no results in the treatment of giant-cell sarcoma to justify the substitution of radium or X-ray as a method of choice, in preference to curettage supplemented by prophylactic toxins and radium or X-ray. A considerable number of permanent cures have been obtained by the latter method, which method has the advantage of greatly shortening the period of treatment and the consequent disability. While it is true that the diagnosis of giant-cell sarcoma of the long bones can be made by clinical and X-ray evidence alone in the majority of cases,

there is a chance of error in about thirty-three per cent. of the cases. Doctor Herendeen found that in twenty-four cases in which the diagnosis of giant-cell sarcoma was made on clinical and X-ray evidence, the subsequent history of the case showed that the diagnosis was wrong in seven cases.

There have recently been observed at the Memorial Hospital two cases which illustrate very well the disadvantages of relying upon the clinical and X-ray evidence for a diagnosis in long-bone tumors; (1) patient had been treated for nearly six months elsewhere as a case of productive osteitis of the tibia; this was the opinion of many expert surgeons and X-ray men who had seen the case; at the end of six months when it became evident that the trouble was a malignant tumor rather than osteitis, amputation was performed, but it was too late to save the life of the patient; (2) a tumor of the upper end of the femur which, from the clinical and X-ray evidence, seemed undoubtedly a giant-cell sarcoma of the benign type; after eight months' treatment, with little improvement, exploratory operation was performed with curetting; the tumor proved to be a degenerating chondroma or a chondro-sarcoma (Doctor Ewing's diagnosis); by this time the patient's general condition was so poor that an amputation was no longer possible.

FIG. 24.—(Case No. 14 in text.) Patient well 7½ years later.

I believe that the question of whether radium or X-ray is the best method of treating giant-cell sarcoma of the long bones should still be regarded as subjudice. Doctor Herendeen, at the Memorial Hospital, is making a very careful study of the effect of the high-voltage X-ray machine in a series of these cases; and we are also using radium in another series of cases; but sufficient time has not yet elapsed to determine the end-results. Dr. Robert Abbe, I believe, was the first one to point out the very remarkable effect of radium on a giant-cell sarcoma of the jaw, in which case the jaw was completely restored in form and function and the patient remains in good health twenty years later (published with illustrations in the *Medical Record*, 1893–4). The treatment of giant-cell sarcoma of the long bones, however,

is, in my opinion, a much more difficult problem than that of the jaw. If it can be proven that better or even as good results can be obtained with radium or X-ray than by curettage and escarotics followed by toxins or radium, I am very certain that the surgeon will be only too glad to substitute X-ray or radium as the method of choice.

We believe that Bloodgood's latest statistics furnish convincing evidence of the efficacy of the plan of treatment which he advocates, *i.e.*, immediate and very thorough curettage; washing out the cavity with carbolic acid, alcohol and zinc chloride (50 per cent. solution); and if the frozen section shows any evidence of sarcoma, introducing radium needles at the time of operation; leaving the wound open for subsequent study of the tissue filling up the cavity, and for further treatment if necessary. The introduction of radium needles, we believe, unnecessary and may perhaps lead to infection.

FIG. 25.—(Case No. 14 in text.)

In regard to the use of radium alone in these cases, Bloodgood states: "My personal observations in a few cases do not confirm the view that radiation is a specific therapy for giant-cell tumors." Kelly reports a case of a tumor of the lower end of the radius which had recurred after two curettings; and prolonged radiation through intact bony shell had had no effect; a third curettage with introduction of radium was followed by apparent cure. Bloodgood had another similar personal case. He states that Gaensler, after a first curettage, introduced radium; "but we have no proof that the radium accomplished a cure in this case."

While we completely agree with Bloodgood on the method of conservative treatment of central tumors of the long bones, we are even more conservative than he is in that we not only abandon the use of amputation in these cases, but resection as well in a certain group which are clinically and microscopically benign. Furthermore, our series shows that the very considerable portion of bone that has been destroyed can be entirely repaired by Nature, with restoration of function, without any bone graft.

In addition to curettage and escharotics, we believe it advantageous to use the mixed toxins of erysipelas and bacillus prodigiosus, and radium pack, if available, but not until the cavity has nearly closed, thereby greatly decreasing the number of recurrences and hastening the recovery of the patients.

I believe it unwise to introduce radium tubes into the cavity of bone after curettage. In those cases, which clinically and microscopically appear to be malignant or probably malignant, we would use the same method of treatment; but if after a very few weeks, the disease is not controlled, we would then amputate, and follow the operation by toxin treatment. We believe that many lives are lost by prolonging conservative treatment in this type of case, which might be saved by earlier amputation. Up to the present time, we have no evidence to prove that a single central malignant sarcoma of the long bones or a single periosteal osteogenic sarcoma has been cured by radium or X-ray alone, or even combined with curettage. Hence it would seem unwise to continue for any length of time, radium and X-ray treatment in these cases, with the possibility and even probability of metastases developing during such treatment. Our opinion that earlier amputation should be performed in the malignant type of central sarcoma as well as in the osteogenic periosteal sarcoma group is supported by the fact that of 38 cases of sarcoma of the long bones treated by amputation followed by prophylactic treatment with the toxins of erysipelas and bacillus prodigiosus, 22 of the patients were alive and well from 2–28 years; 20 were alive from 3–28 years, and 9 were alive and well from 9–28 years. Of these 22 cases, 4 were central giant cell (3 of the femur and 1 tibia), in which conservative treatment had been tried and failed; 18 cases were periosteal sarcoma (a microscopical diagnosis was made in every case), and of these, 17 were well from 3–28 years, and one died eight years later of metastases in the lungs.

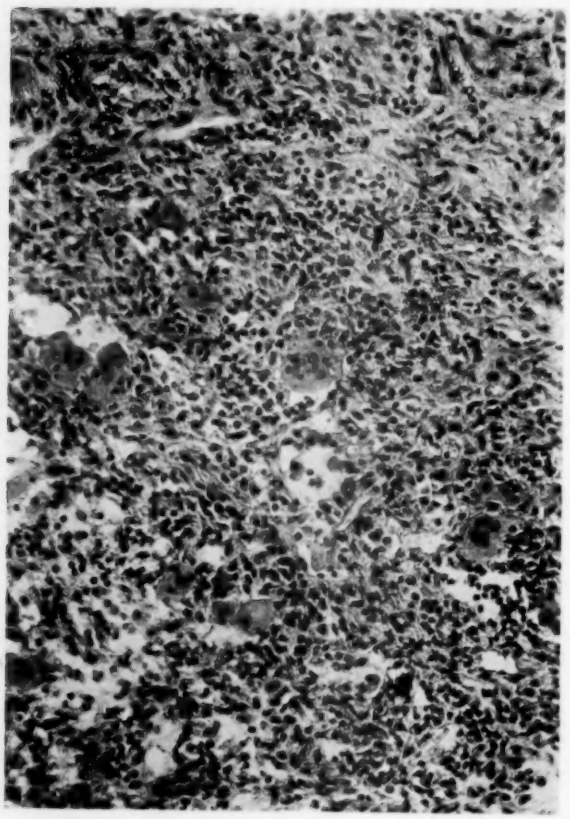

FIG. 26.—(Case No. 14 in text.)

Treatment in Personal Series of Cases.—In the present series of cases, primary amputation was done in 11 cases; it would seem good evidence that conservative treatment was not indicated in most of these cases from the fact

that seven of the patients later died of metastases, one, six years after amputation; of the others, two are living, one, twenty years later, and one, six years later. Amputation was employed in eight other cases, but not until conservative treatment had been tried; in two of these cases amputation was done for infection, after the disease has been apparently controlled; and in one, for the severe pain associated with radium burn. In one case, a giant- and spindle-cell sarcoma of the lower end of the femur,

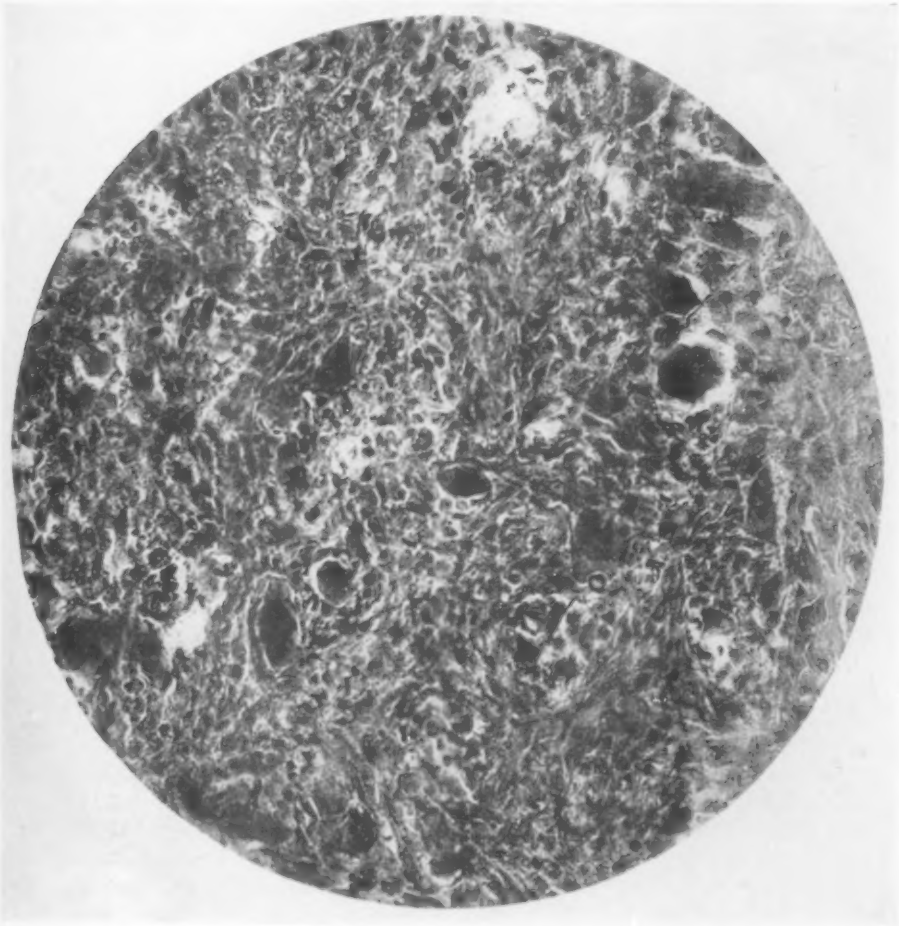

FIG. 27.—(Case No. 14 in text.)

amputation was done more than a year after toxin-treatment had been given, when the disease was under apparent control, for an injury to the popliteal artery caused by spiculæ of bone from a pathologic fracture; the patient remained well more than ten years later. In four cases amputation was done after conservative treatment had been tried and failed; one of these cases was treated with toxins and curetting, with apparent recovery; recurrence took place eight months later; amputation; patient

well two years later. The other three cases were treated with X-ray in one case, and radium in two cases; two died of metastases, and one is well at present, six months later.

A brief explanation of the end-results in the eleven cases of giant-cell sarcoma treated by primary operation:

1. T., male, extensive giant-cell sarcoma of lower end of femur (see case No. 21 in Femur Table); amputation performed at the Chatham General Hospital, Ontario, Canada, followed by toxin treatment given under my direction. The patient was well when last traced, six years later.
2. R., female, central sarcoma of lower end of femur (see case No. 20 in Femur Table). Amputation was performed twenty-two years ago by Dr. Vander Veer of Albany, N. Y.; no prophylactic or other treatment was given later. The patient came under my observation two years ago, for another trouble; at that time there was no evidence of a return of the sarcoma, twenty years after the amputation. I obtained a slide of the original tumor from the Bender Laboratory; and it was pronounced a typical benign giant-cell sarcoma.
3. B., male (see case No. 1 in text).
4. F., female (see case No. 7 in text).
5. W., female, central sarcoma of upper end of tibia; amputation by Doctor Bull in 1900; patient came under my care six years later, suffering from lung metastases. The original tumor had been pronounced a giant-cell sarcoma by a competent pathologist; but Doctor Ewing, on reviewing the slides after the death of the patient, pronounced it a malignant giant-cell sarcoma, not the benign type.
6. S., (see No. 10 in text).
7. R., female, giant-cell sarcoma involving lower portion of shaft of femur (see case No. 4, Femur Table). Amputation performed followed by toxin treatment; the patient remained well for nearly three years and then died of extensive metastases involving the bones of the pelvis and lungs.
8. S., male, giant-cell sarcoma of tibia (see case No. 6 in Tibia Table).
9. H., (see case No. 5 in Humerus Table).
10. R., male, giant-cell and spindle-cell sarcoma of fibula; (see case No. 9 in Radius Table).

    Excision of very large tumor with entire fibula; wound treated by Keating-Hart fulguration before being closed; three days later, there developed extensive gas gangrene, for which I did an immediate amputation; good recovery; end result not known.
11. Doctor P's case; (see case No. 13, Tibia Table), sarcoma of upper end of tibia; amputation was performed, after which I was consulted as to further treatment. The toxins were advised as a prophylactic measure; but the treatment was not carried out. When last traced, several years later, the patient was still in good condition.

In 7 of this group of 11 cases, metastases developed; in 3 of the cases (Nos. 3, 4 and 7) the amputation was performed by myself, and in No. 5, by Doctor Bull, so that I had an opportunity of studying the sections in only four cases of this group. A microscopical examination was made in case Nos. 3 and 4 by Doctor Ewing; in both of these cases, the tumor was of such rapid growth, and the clinical features so typically malignant, that I did an immediate amputation without exploration. On reviewing case No. 3, Doctor Ewing stated that it was a highly malignant telangiectatic sarcoma, and that his original report was an error in diagnosis. In case No. 4 the clinical history

of very rapid growth prior to the amputation, rapid recurrence, and death within a few months, prove that this case, likewise should not be classed in the benign giant-cell group. Case No. 7 clinically, and from the X-ray pictures, closely resembled a benign giant-cell tumor; the microscopical diagnosis in this case was giant-cell sarcoma (Doctor Jeffries); but the slides were lost in moving from the old Polyclinic Hospital to the present hospital, so that I have not been able to get other opinions on the histological structure of the tumor. In this case, the patient had prolonged toxins after amputation, which may or may not have had anything to do with the fact that she remained well for three years before metastases developed. In case No. 5, the tumor had been pronounced a giant-cell sarcoma by a most competent pathologist at the time of the operation; but Doctor Ewing, on reviewing the slide after the death of the patient, stated that it was not of the benign giant-cell type. In the other cases, I have not been able to obtain any slides of the tumors. But the fact remains—and an important fact—that, at the time of the operation, the diagnosis of giant-cell sarcoma was made by competent pathologists in all of the 7 cases in which metastases later developed. In one case only, case No. 6, did the pathologist state that there were present two different types of giant cells, the benign and malignant, making the prognosis doubtful.

FIG. 28.—(Case No. 15 in text.) Giant- and spindle-cell sarcoma of upper end of tibia, complete destruction of 5 inches of bone. Treated by curettage, toxins and radium. Picture shows condition five years later; replacement of new bone.

From the point of view of furnishing important aid to the surgeon in enabling him to determine the best method of treating these cases, it is the primary diagnosis of the pathologist, made at the time of the operation, and not the one made after the end-results are known, that is of account.

Locality in Personal Series of Long-bone Cases.—Femur, 22 cases; tibia, 13 cases; humerus, 6 cases; fibula, 2 cases; radius, 7 cases; ulna, 1 case. Total, 51 cases. In addition, we have observed 10 cases of giant-cell sarcoma of other bones: Jaw, 3 cases; spine, 3 cases; sacrum, 1 case; ilium, 2 cases; sternum, 1 case. Total, 10 cases.

In 19 of 22 femur cases, the disease occurred in the lower third and in 3 cases in the upper third; in 13 tibia cases, the upper third was the seat of the disease in 12 cases, in 6 humerus cases, the disease occurred in the upper third in 5, and in the shaft in 1 case.

Age.‡—Five to 10 years, 4 patients; 10 to 15 years, 5 patients; 15 to 20 years,

‡ While Bloodgood believes that giant-cell sarcoma rarely occurs under the age of fifteen years, our present series shows nine patients less than fifteen years of age, and four patients less than ten years.

8 patients; 20 to 30 years, 17 patients; 30 to 40 years, 6 patients; 40 to 50 years, 5 patients; 50 to 60 years, 4 patients; over 60 years, 1 patient; total, 50 patients.

Duration of Disease.—Less than 6 months in 25 cases; from 6 months to 1 year in 9 cases; from 1 year and over in 6 cases; not known in the remainder.

Trauma.—In 28 or 56 per cent. of the cases there was a history of antecedent trauma; in 15 cases there was no trauma; and in 7 cases it was not stated.

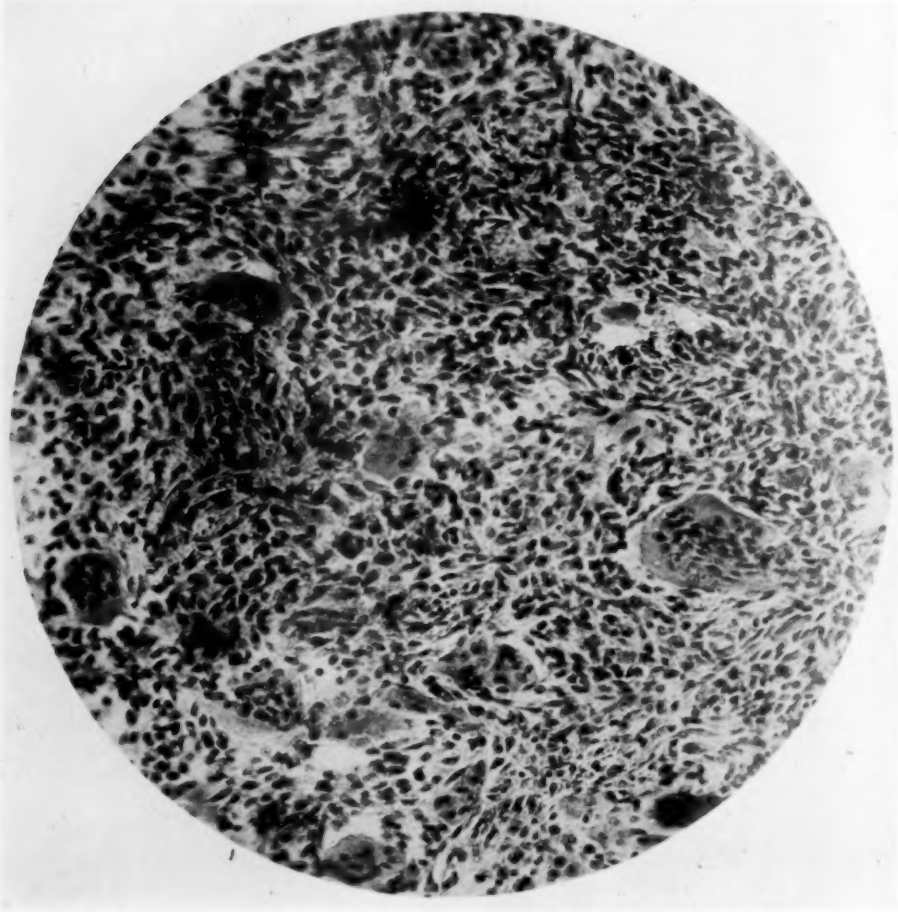

FIG. 29.—(Case No. 15 in text.)

As to the nature of the trauma: in 5 cases there was a sprain, in 6 cases a recent fracture, in 5 cases a blow and in 12 cases a fall.

Sex: Male ..... 23 cases
Female ..... 27 cases

Microscopical Examination.—A microscopical diagnosis of "giant-cell sarcoma" was made in 38 cases; of "giant- and spindle-cell sarcoma" in 5 cases; of "microscopically spindle but from clinical X-ray examination a typical giant-cell sarcoma" in 1 case. There was no microscopical examination made in 6 cases. In 23 of the 44 cases, the microscopical examination

was made by Doctor Ewing. In many cases, the diagnosis was confirmed by several pathologists.

Method of Treatment in Living Cases

Toxins alone	3 cases
Toxins and curettage	5 cases
Toxins, radium, curettage	6 cases
Radium and curettage	4 cases
Toxins and amputation	2 cases
Radium and X-ray	7 cases
Curettage alone	2 cases
Amputation alone	1 case
Resection alone	1 case
X-ray and amputation	1 case
	32 living cases.

Of the entire series of 50 cases, 32 patients are alive, 10 have died (9 of metastases, 1 of nephritis a year and one-half after amputation), 1 patient was in a hopeless condition from metastases when last seen and will probably die, and 7 patients have not been traced. In 24 cases the limb was saved.

End-results

22 femur ..... 17 are living and 8 well, 3 to 20 years later; 5 died (4 with metastases), (1 nephritis, 1½ years after amputation).

13 tibia ..... 7 are living and 5 well, 4 to 17 years later; 3 died of metastases, 3 not traced.

6 humerus ... 2 are living and well, 2 to 4 years later; 3 died of the disease, 1 recent case getting worse.

2 fibula ..... 2 cases traced for only a short period.

7 radius ..... 6 are living and well, 3 to 15 years later; 1 recent case.

1 ulna ..... 1 case seen in consultation; later resected by Doctor Bloodgood; well 10 years.

5 jaw ..... 1 well 8 years, then died of other trouble; 1 died of rapid increase of local disease without definite metastases; no autopsy; 1 not traced.

2 spine ..... 1 living and well, 21 years later; 1 living and well, 2 years later (patient still alive but paralyzed).

1 sacrum ..... 1 case, disease held in check with toxins and radium for 3 years, but not cured.

1 ilium ..... 1 case treated by repeated operations with rapid recurrences; radium tried without success; toxins for a long period, with breaking down of tumor; curettage; patient well 5 years, then died of probable nephritis.

1 sternum .... 1 case, inoperable, with extensive metastases in glands of neck; toxin treatment with marked improvement and apparent control; later died of nephritis.

TO BE CONTINUED

ADAMANTINE EPITHELIOMA OF THE LOWER JAW*

CLINICAL REPORT OF TWO UNUSUAL CASES

By J. Shelton Horsley, M.D.

of Richmond, Va.

In order to comprehend the etiology and structure of the intrinsic tumors of the jaw whose origin is connected with the development of the teeth, it is necessary to review the embryology and the histology of the teeth. There is a rather striking resemblance between the origin of the hair and the teeth. Scudder has called attention to this analogy (Scudder, C. L., Tumors of the Jaw, 1912, pp. 163 and 165). In the first stage of specific development of both hair and teeth, the earliest change noticed is that the deep layers of the epidermis form buds and grow into the tissue beneath it, dipping into the mesenchyma of the alveolar processes. At the same time, a papilla arises from the mesenchyma which grows up into the epithelial cord.

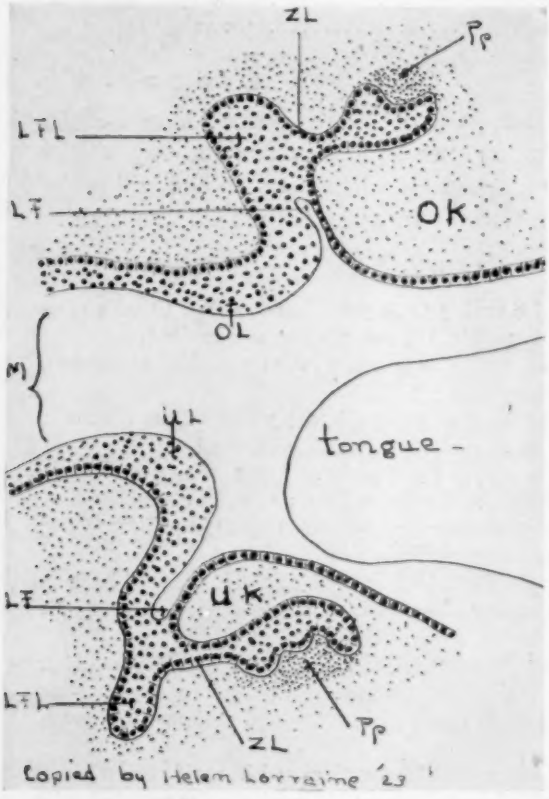

Fig. 1.—Dental anlages from a human fetus, 40 mm. long. (Jordan, Fig. 312.) LF, dental grove; M, oral cavity; OK, mesoblast of upper jaw; UK, anlages of lower jaw; OL, epithelium of primitive upper lip; and UL, of the lower lip; ZL, dental lamina; LFL, labial lamina: Pp, dental papilla. (X 60.) (After C. Röse.)

One of the early stages in the embryology of the teeth is represented by Fig. 1. In a 40-mm. embryo about the beginning of the third month, a shelf of epithelial tissue, a development of the original bud or cord from the under surface of the epidermis, pushes down. This is called the dental lamina. During the third month of fœtal life the anlages of all the temporary teeth are laid down. About the same time a thin portion of this dental lamina buds out and forms the anlages of the permanent teeth. A papilla from the mesenchyma pushes up into the cord of epithelium as shown

* Read before the Southern Surgical Association, December 11, 1923.

in Fig. 2. This epithelial cord is converted into an isolated closed sac, the enamel organ, by the development of a membrane, the dental sac, which severs the epithelial bud from its original stalk and at the same time surrounds the papilla from below. The primitive tooth thus lies within the dental sac which develops about the end of the third month (Fig. 3).

The enamel organ sits upon the papilla as a cap and the papilla pushes into this closed sac. Within this sac is a rather soft material called the enamel pulp. In the earlier stages the sac of the enamel organ reaches almost to the base of the papilla.

From the papilla is developed the dentine, which is the hard ivory substance of the tooth, and upon the dentine in that portion of the tooth which is above the gum rests the enamel, consisting of very hard prisms. These arise from the layer of the enamel organ in contact with the papilla, and are formed by the cylindrical cells nearest the papilla called ameloblasts, into which calcium salts, chiefly calcium phosphate, are deposited, making a substance of extreme hardness. The outer layer of the root of the tooth, or the cementum, is developed from mesenchyma and is formed by ossification of that portion of the wall of the dental sac which covers the base of the dental papilla and the root of the tooth. The cementum has no epithelial connection.

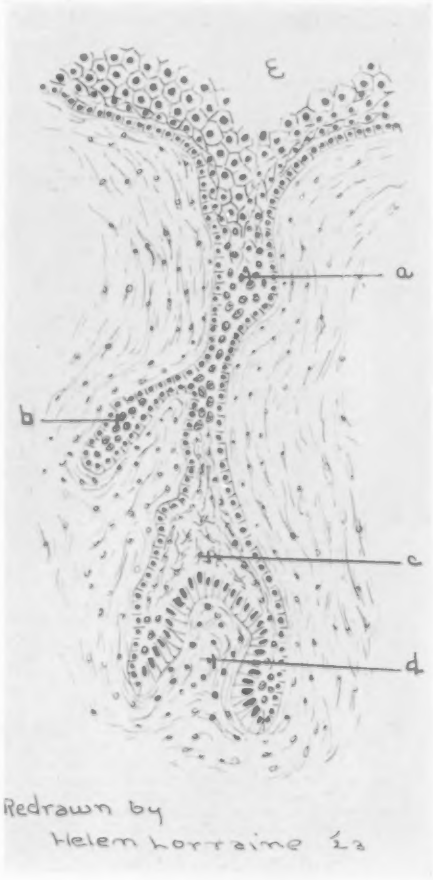

FIG. 2.—Vertical section of cuspid of human fetus, showing the budding of the primitive epithelial cord (X 70) (Marshall's "Operative Dentistry") (Scudder, Fig. 152). A, primitive epithelial cord; B, budding of the primitive epithelial cord; C, enamel organ; D, dentin papilla; E, epithelial cells.

The dentine, on which the enamel and the cementum rest, is developed from cells called odontoblasts, and is penetrated by an abundant system of canals containing branches from the odontoblasts and nerves.

The enamel pulp consists of soft material within the enamel sac and at first seems to resemble syncytial tissue. As the tooth develops, the cells take form and become stellate with long anastomosing processes. No blood-vessels penetrate the enamel organ, though blood-vessels, nerves and lymphatics communicate freely with the papilla through the dental foramen below. (Fig. 4.)

The outer layer of the enamel organ which lies on the interior of the

dental sac except at the base of the tooth forms several layers of flattened epithelium. According to Jordan (Jordan, H. E., Text-book on Histology, 2nd edition, 1920, page 335), "Remnants of this cell layer frequently persist in relation to the inner margin of the bony alveolus." The bony alveolus is formed by ossification of the connective tissue around the embryonal dental sac. Such remnants of epithelial tissue can give origin to the epithelial tumors which are found in connection with the teeth. The dental root cyst may arise from portions of this epithelium attached to the root of the tooth and carried down into the jaw by the development of the root. The dentigerous cyst comes from the abnormal development of the dental sac.

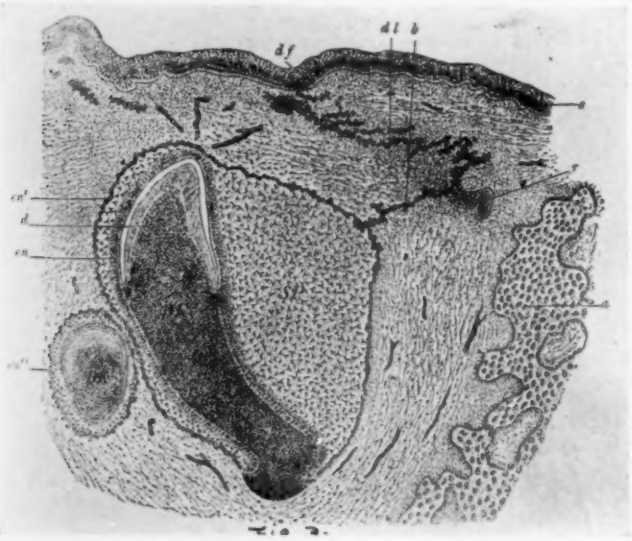

FIG. 3.—Section of first milk incisor of a human embryo 30 cm. long. Frontal section through lower jaw. (X 30.) (Röse.) (Schaffer, Fig. 739.) DK, tooth pulp; d, odontoblasts; a, bone of alveolar process of jaw; en, en', inner and outer layers of enamel organ; SP, enamel pulp; df, dental furrow; e, mouth epithelium; dl, remains of dental lamina; b, cell bridge connecting this with tooth germ; r, reserve germ for permanent tooth; en'', germ of 2nd milk incisor cut obliquely.

One of the most interesting tumors of the jaw is the adamantinoma, or adamantine epithelioma, to which the excellent work of Bloodgood has called attention. This tumor, while unusual, is not rare. In its development, columnar cells are conspicuous. These are supposed to be analogous to the ameloblasts of the enamel organ and often form what resemble tubules or acini, containing, however, a structure like the enamel pulp with poorly differentiated star-shaped cells, or, in some instances, apparently squamous epithelial cells. Not infrequently this material forms a cyst which may enlarge, probably by coalescence with adjoining cysts, and make a cavity of considerable size. Some authors, as Broders, A. C., and MacCarty, W. C. (Epithelioma, Surgery, Gynæcology and Obstetrics, vol. xxvii, August, 1918, pp. 141–151), and Buchtemann and Kolaczek, think that the adamantinoma develops directly from the epithelium of the gum and not from the enamel organ. The accompanying two photomicrographs, kindly given by A. C. Broders (Figs. 8 and 9), are very suggestive of such an origin. The columnar cells that are found in adamantinoma resemble somewhat the basal cells of the epidermis of the gum.

According to Broders and MacCarty, the stellate cells, which are supposed to correspond to the enamel pulp, may resemble the prickle cells of the

epidermis. Then, too, they assert that cysts similar to those usually found in adamantinomas are also seen in squamous-cell cancers as a result of the degeneration of cells. As the enamel organ arises from the under surface of the epidermis of the gum, it is quite possible that the adamantinoma may come directly from this tissue. There are many basal cell cancers in which this same type of columnar epithelium of an adamantinoma, corresponding to the basic or germinal layer, is found. (Figs. 10 and 11.) The clinical course of adamantinoma, however, is quite different from that of basal-cell cancer.

Of the two cases reported here, the first seems a direct descendant of remnants of the enamel organ. In the other, which contains what appears to be epithelial tissue, the origin is more obscure.

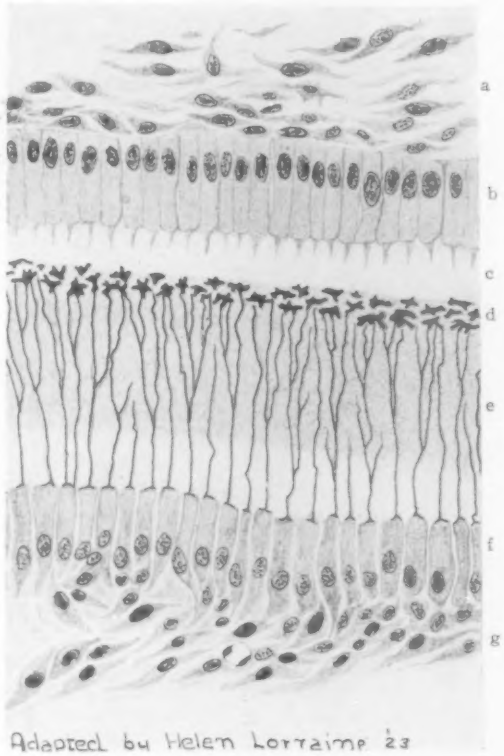

FIG. 4.—Section of developing tooth through junction of enamel and dentine. (X 400) (Modified from Piersol.) a, intermediate layer of enamel organ; b, ameloblasts; c, young enamel with Tomes' processes; d, granular layer Tomes; e, dentine; f, odontoblasts g, embryonal pulp-tissue.

CASE I.—Mrs. J. E. W., aged twenty-nine, referred by Dr. B. F. Royal, of Morehead City, N. C., entered St. Elizabeth's Hospital on January 16, 1919. She had ptosis of the stomach and transverse colon, cholecystitis, and a cyst in the right lower jaw. This was thought to be a dentigerous cyst. The cyst was first noticed in 1917, though there had been pain in the lower jaw for the past eleven years. The pain was frequently rather severe. About nine months ago some operation was done by another surgeon, and a few months later operation was performed upon the cyst. The technic of these operations could not be determined, but it was doubtless an incision from within the mouth. No permanent relief was obtained. On January 17, 1919, I operated, plicating the gastrohepatic and gastrocolic omentum and removing the gall-bladder, which was very adherent. After completing the abdominal operation, a transverse incision, on a level with the lower portion of the ear, was made over the cyst in the jaw. The cyst seemed to be about two inches in diameter. It appeared bluish in color, and there was no bone covering this portion of its exposed wall. The cyst was incised, and more than an ounce of slightly muddy fluid was evacuated. The cyst wall was removed as far as possible by curetting. The cavity was filled with the Moorhof iodoform plug, and the wound was closed in layers with tanned catgut. Convalescence was satisfactory except that some of the Moorhof plug worked through the incision and the scar was very prominent. On February 12, 1919, the scar was excised under local anæsthesia,

and the wound united with a subcuticular stitch of silkworm gut, over which was placed an epidermal suture of fine silk. She was discharged February 17, 1919.

The patient returned on May 31, 1923. The growth on the jaw had increased in size. After leaving the hospital in February, 1919, she felt well for several months; then pain of a dull aching character began in the left lower jaw, and occasionally extended down her neck and to the back part of her head. During the last six months there has been a marked increase in the size of the growth in the lower jaw, which for a time after the operation was hardly observable. The pain has also increased.

FIG. 5.—Drawing of specimen removed from Case I, external view. On the right is a small margin of healthy bone with the alveolar process containing three teeth. On the left the tumor has been exposed during removal of the growth, and below attached enlarged lymph-nodes which on section were merely hyperplastic.

On inspection there was a large growth in the right lower jaw. Röntgenographic report by Dr. Fred Hodges follows: "There is an extensive cystic involvement of the bone extending from the first bicuspid tooth back beyond the angle of the jaw on the inferior border; and on the superior border, practically back to the condyle of the jaw. The jawbone is practically entirely destroyed, and there are a good many bony septa dividing this area into many different parts."

On June 1, 1923, the patient was operated upon under gas-ether. An incision was made from about the middle of the right mastoid process downward, forward and inward, along the border of the lower jaw to the middle of the neck. The tissues were dissected down, and the facial vessels were doubly clamped and divided. The whole mass of tissue was dissected up, taking care to keep close to the jawbone. The wall of the tumor was exceedingly thin, and at one point anteriorly was opened. A small amount of thick, clear, yellowish fluid containing some flocculent particles was evacuated. This was washed off with sterile water. The dissection was carried beneath the jaw, and the attachment of the muscles to the right half of the jaw was severed. Anteriorly there were a few enlarged lymph-nodes, and these were left attached to the tumor. The incision was carried through the lower lip and the bone was divided anteriorly, about one-half inch in front of the diseased tissue. The growth was then retracted outward, and the dissection was made internally, preserving as much mucosa as possible and packing the mouth with gauze to prevent aspiration of blood. The bone was severed posteriorly with bone forceps. The growth involved the anterior portion of the ramus of the jaw. A small fragment was left at the upper part, and this was removed separately. The raw surface at the stump of the bone was cauterized with

the electric cautery. The mucosa of the mouth was sutured with a continuous suture of tanned catgut. The skin wound was closed with a continuous suture of silkworm gut, leaving a drainage tube through the posterior end of the wound. No effort was made to fill in the defect left by removing the jaw, as the mouth cavity had been widely opened and it was felt that a graft would not take at this time. The operation lasted one hour and twenty minutes.

The specimen consists of the tumor from the lower jaw, together with one lymph-node which is enlarged and soft. The tumor is three and one-half inches long, by two inches wide. On the upper surface is the alveolar process with three lower teeth anteriorly. They seemed quite firmly imbedded in the gum. Externally most of the growth consists of a bulging out and thinning of the bone until at most places the bone is merely the thickness of parchment and over some areas has disappeared. Both anteriorly and posteriorly there is about one-half inch of healthy jawbone, except at the upper portion posteriorly, where the section was made partly through diseased tissue and the small remaining fragment of diseased tissue removed with bone forceps. (Fig. 5.)

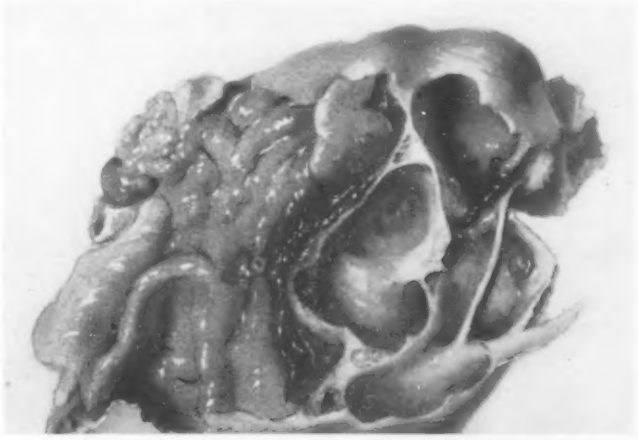

FIG. 6.—Drawing of specimen shown in Fig. 5. An incision has been made along the outer wall. Note the thin capsule of the growth, and in the right side a cyst containing smooth walls with imperfect partitions. Through about the centre of the specimen is a complete partition, and on the left is soft content. To the left of the central partition the material is a dark purplish color. In other portions the solid material is yellowish.

Longitudinal incision with a knife shows in the lower half of the specimen several cavities whose walls are lined with a thin membrane, beneath which is a very thin layer of bone. The bone can be readily dented with the finger. There is a small bridge of bone along the alveolar process containing the teeth. Just in front of what corresponds to the angle of the lower jaw and internally the wall of the tumor is very thin. The cysts communicate, and there are incomplete partitions between them. The wall is smooth. In the upper posterior portion of the specimen, there is a solid mass of tissue which fills a compartment. This is rather soft and most of it is a pale yellow, though anteriorly and below the tissue is purplish in color. All of the tissue can be easily separated from what appears to be the capsule, which resembles very much the wall of the cysts that contained fluid. (Fig. 6.) The lymph-node on section is oblong, about an inch in diameter, and soft. It seems to be hyperplastic. Microscopic sections in celloidin show typical structure of adamantine epithelioma, or adamantinoma. The columnar cells are abundant, and are arranged somewhat irregularly as tubules or as acini. In portions of the growth there is a myxomatous-like material with stellate cells resembling enamel pulp. (Fig. 7.) The patient made a satisfactory recovery from the operation, and left the hospital on June 20, 1923.

Under date of December 6, 1923, in a letter from Doctor Royal, the patient's family physician, he says that soon after returning home the patient had a small

sinus in the chin, which led down to the bone. He dilated and curetted this sinus, and it promptly healed. He has not seen her very recently. He says the deformity is inconspicuous, being only a slight flattening, and the scar is hardly visible as it lies largely in the fold of the neck.

Under date of December 8, 1923, the patient writes me that so far as she can tell there is no recurrence, but that the jaw pains her some, and "swells when I eat or worry." The swelling may be due to the action of the parotid gland.

CASE II.—This patient, Mrs. A. R. T., aged forty-one, referred by Dr. J. Bolling Jones, of Petersburg, Va., entered St. Elizabeth's Hospital, on May 19, 1918. The family history was of no significance. She first noticed some swelling under her tongue on the right side of the mouth about twenty years ago. This, however, did not trouble her until the last few years, when it enlarged and the jawbone apparently was affected. She had been operated upon about two years before this by another surgeon, who had removed a portion of the alveolar process from the lower right jaw.

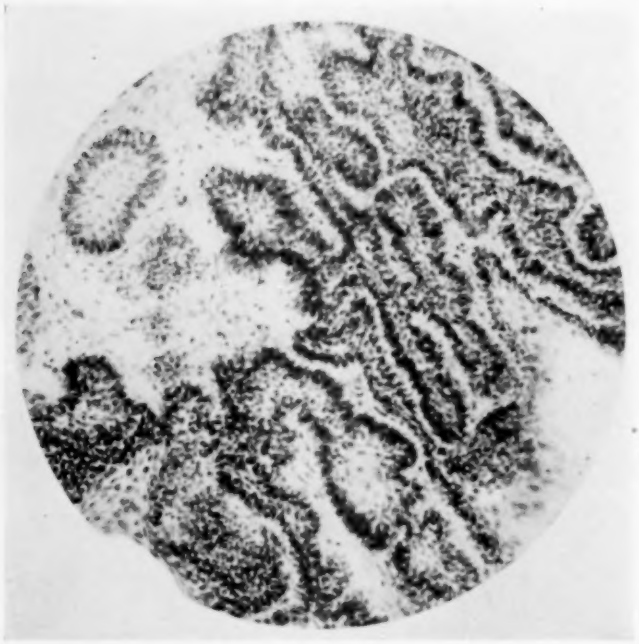

FIG. 7.—Photomicrograph of the tumor shown in Figs. 5 and 6. The columnar cells of which this growth is largely composed are arranged somewhat irregularly as tubules or acini. In the lower right corner is part of a mass of tissue resembling somewhat enamel pulp. Areas of this kind are common in the section, and often are of large proportions. (X 150.)

There was a recurrence of the growth. It involved the lower jaw on the right side, extending from a short distance from the symphysis back to near the angle of the jaw. It was rather sharply circumscribed, though it apparently infiltrated the immediate tissue along the adjacent portion of the floor of the mouth.

An incision was made along the lower border of the right side of the jaw, extending up over the chin in the midline. The bone near the midline was divided with a wire saw. The growth was dissected out with the electric cautery, taking care to include the adjoining adherent tissue. The jaw was sawed posteriorly at the angle. A graft was taken from the tibia. The ends of the graft and the stumps of the bone of the jaw were drilled and the graft was fastened in position with kangaroo tendon. An effort was made to suture the mucosa of the mouth over the graft. There was some tension in the suturing, and the mucosa could not be satisfactorily approximated. The wound was closed and a small drain of catgut was inserted at the posterior angle.

The specimen consists of the right side of the lower jaw extending from near the symphysis to a point just anterior to the angle of the jaw. The specimen

measures two and one-half inches in length. At the two extremities there appears to be healthy normal bone. Between these there is a tumor which bulges the bone in all directions. On the internal surface of the tumor a small amount of soft tissue is adherent. This presents a charred appearance resulting from the dissection with the electric cautery. There is a very thin capsule of bone around most of the growth. At other points the bone seems to be entirely missing, and is replaced by a fibrous capsule. Where the bone is present it is exceedingly thin and can be easily dented with the finger. (Fig. 12.) On section the tumor seems to be solid without any cystic formation. The jawbone has been expanded and absorbed, so that the thin capsule can be readily cut with a knife. The tumor has a yellowish appearance with occasional red specks. It is moderately firm, but elastic. It is not encapsulated, though it is distinctly circumscribed. It appears

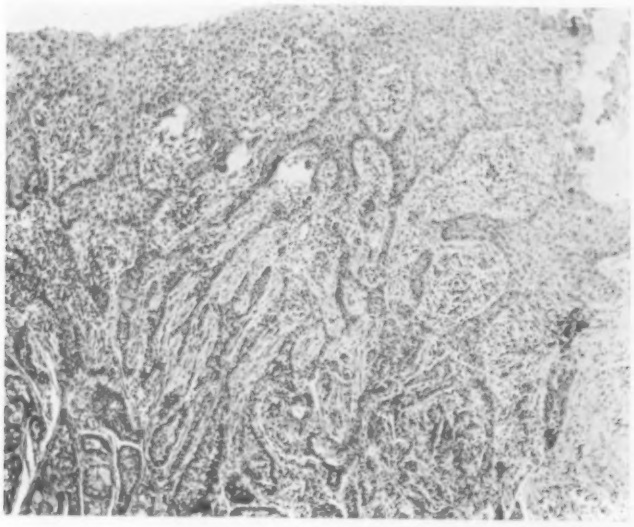

FIG. 8.—Photomicrograph of adamantinoma showing apparent origin of growth from the epithelium of the gum. (X 50.) (From A. C. Broders.)

to displace the tissue as it grew, though there is some infiltration at certain areas. This, however, is limited. (Fig. 13.) A block is taken for celloidin section. (Fig. 14.)

Infection followed, and the graft had to be removed. The wound gradually healed, and the patient left the hospital on June 21, 1918.

On October 1, 1920, she was admitted to the hospital, and a sebaceous cyst of the scalp was removed and a small enlargement on the alveolar process of the left side of the jaw was removed with a curette and the tissues were thoroughly cauterized. There was no evidence of any growth on the right side. Microscopic examination did not show this tissue to be a recurrence.

On September 23, 1921, she was admitted with a small recurrence, and operated upon. The anterior part of the incision in the neck which was made in the first operation was incised and the end of the jawbone was exposed. A small portion was cut away with bone forceps. The bone appeared to be normal. There was a nodule in the floor of the mouth on the right side about an inch from the bone. This was dissected out without opening the mucosa and the tissue was examined with frozen sections. The nodule was firm and about one-quarter inch in diameter. A frozen section showed malignancy. The tissues around the nodule were thoroughly cauterized with electric cautery without penetrating to

the mouth. The wound was closed with silkworm gut, leaving a rubber tube for drainage. A small nodule on the exterior surface of the bone about two inches from the midline was exposed and curetted. There appeared to be no evidence of malignancy. This wound was thoroughly cauterized with the electric cautery. The operation lasted fifty minutes.

The specimen consists of the small piece of tissue described in the operation. A gross section shows a firm, yellow growth that is not encapsulated. There is a small amount of muscular tissue attached. Microscopic section shows the growth of the same nature as the original. The histologic appearance of the original tumor removed by me was so unusual that I was unable to make a definite diag-

FIG. 9.—Section from the central portion of the tumor shown in Fig. 8, which gives a more characteristic appearance of adamantinoma. (X 50.) (From A. C. Broders.)

nosis except that it was malignant. Sections or blocks of tissue were submitted to several prominent pathologists.

Dr. J. C. Bloodgood, under date of August 2, 1919, said: "This section shows tubular alveoli of cells whose nuclei take the hæmatoxylin stain, imbedded in a very fibrous stroma. These alveoli are not all tubular; some are irregular masses and the question is what these cells are. They do not resemble adamantine epithelium. They show more pearly body formation. Many of the cells are vacuolated. They do not appear to be a type of sarcoma. I am inclined to think that the diagnosis rests between a carcinoma arising in the gum, or one of the rare forms of adamantine epithelioma, in which the peculiar degeneration is not well marked. I shall diagnose it *jaw adamantine epithelioma* until I hear more definitely from Doctor Horsley."

Dr. A. C. Broders, of the Mayo Clinic, under date of July 15, 1918, says: "From the tissue that you sent from Mrs. T. some time ago, I have made a number of slides, staining some with hæmatoxylin and eosin and also some for fat. Those stained for fat showed the tumor cells to be free from it. It is extremely difficult to say whether this is a sarcoma or carcinoma. At any rate, it is a malignant tumor, though apparently of a low grade." Later, after another study of

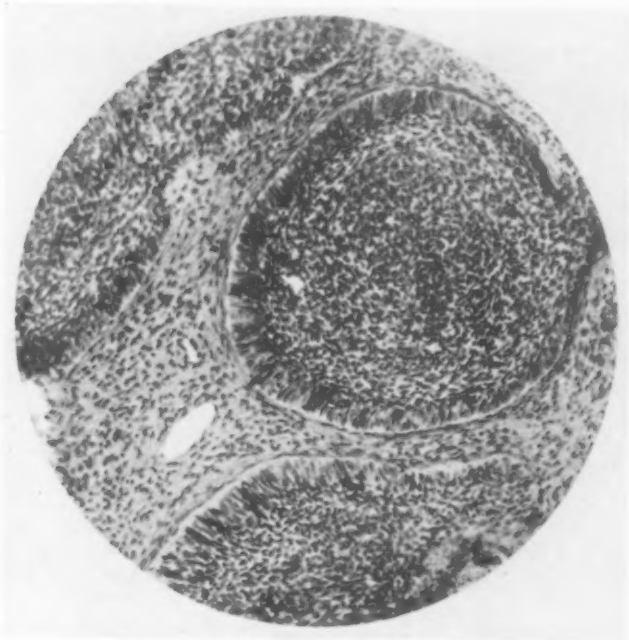

FIG. 10.—Basal cell carcinoma from the skin over the eyebrow showing columnar epithelium similar to that found in adamantinoma, though the cells surrounded by the columnar epithelium are of a different type from the enamel pulp. (X 150.)

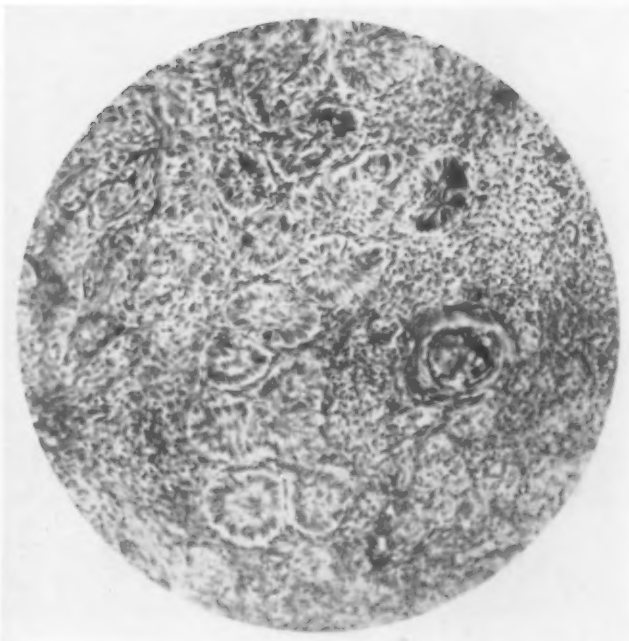

FIG. 11.—Photomicrograph of small growth removed from the skin near the inner canthus of the eye. It shows in the upper portion of the photograph spinous cell type of cancer with a "pearl". In the central portion it is a basal cell type, with columnar cells resembling those found in adamantinoma. (X 150.)

this tissue in August, 1923, he said the tissue showed "epithelioma belonging to the squamous-cell family of adamantine type, of low-grade malignancy," and

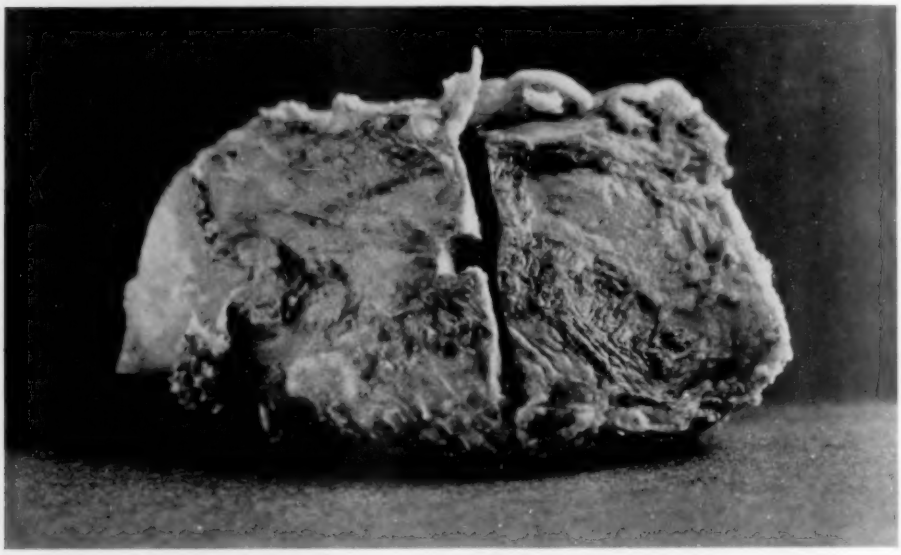

FIG. 12.—Photograph of specimen removed from Case II. At both ends there was apparently healthy bone.

that a section removed from the last operation showed a recurrence of the original growth.

Dr. Alfred Stengel, of Philadelphia, was interested in the growth and was good enough to go over the sections. His report, under date of December 11, 1921,

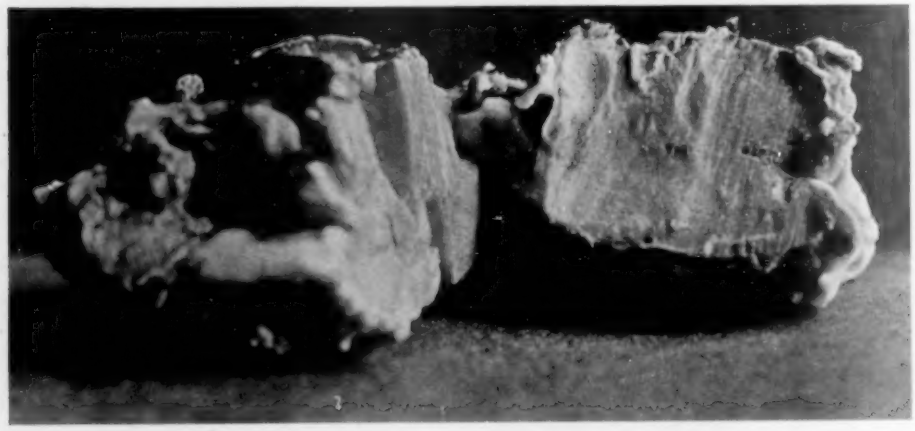

FIG. 13.—Photograph of a section of the tumor shown in Fig. 12. The capsule is thin. The bone in some areas has entirely disappeared. The growth infiltrates as well as expands the surrounding tissue.

is as follows: "The microscopic slide of the very interesting tumor regarding which we spoke at Lynchburg reached me in good time and I have been examining it with several of my colleagues here who were as much interested as I. Dr. Herbert Fox and I first looked it over and concluded that it was not an adamantinoma, but

we could not quite agree what we did think it. Both of us were impressed with the curious resemblance of the cell groups to those of certain hypernephromata. I was rather of the opinion that the cells have an epithelial appearance, the stroma being, of course, a very curious feature as well. Doctor Fox, I think, was rather inclined to believe it a dental tumor of some sort, though he did not express nor was he willing to express a positive opinion. We then submitted it to Dr. Hopewell Smith, the histologist of the Dental School, and Doctor Ivy of the Dental School, both of whom examined it carefully and stated that they did not believe it a dental tumor of any sort. Neither of them, however, was willing to commit himself to a positive opinion as to what the nature of the growth might be. All of us, of course, agreed that it was a form of malignant tumor. I confess that I have never seen anything like it and am no more able to reach a conclusion than were the others. The epithelial or endothelial character of the large cell nests impressed me, but I hesitate to say what I would call the thing if I were pinned down to an expression of a positive opinion. I believe that Dr. Joseph McFarland also looked at it, but did not come to any conclusion regarding its nature."

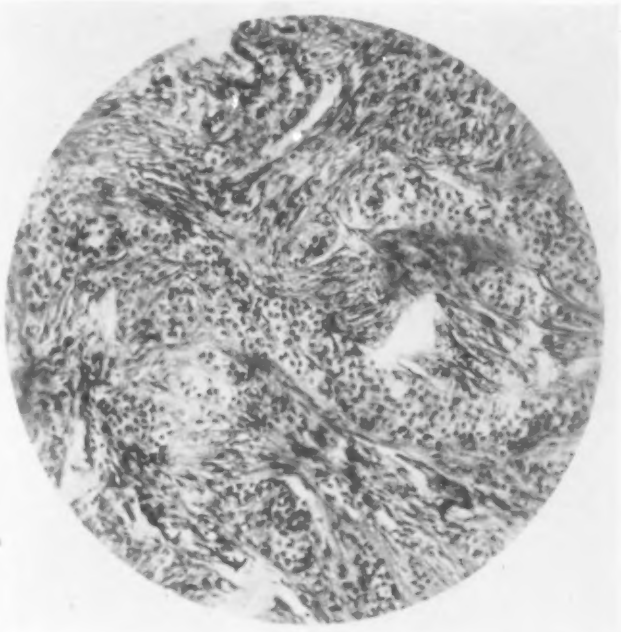

FIG. 14.—Photomicrograph of tumor shown in the preceding figures. The portion from which the block was removed is shown in the photograph. The cells seem fairly well differentiated. The cytoplasm is clear. The cells are arranged irregularly in columns or are grouped together in masses. The stroma is well organized but delicate connective tissue. The growth is evidently malignant, though of a grade of malignancy. Most of the pathologists are inclined to think it springs from the tooth ramus. (X 140.)

The exact nature of the growth seems difficult to determine. Most of the pathologists feel that it is an epithelial growth, probably of adamantine origin, though an endothelial origin can not be entirely discarded.

Under date of December 6, 1923, Dr. J. Bolling Jones, of Petersburg, reports that he has examined Mrs. T. and finds the condition satisfactory, except for "A distinctly enlarged gland the size of a cherry at the posterior inferior angle of the scar on the neck. It is unattached to the skin or scar, and is freely movable and apparently has very little deep attachment. It is in very close proximity to the common carotid, yet apparently not attached to it." Doctor Jones says that according to the patient's statement this lymph-node has been present for eighteen months, and she does not think it has changed in size. In his opinion it would be impossible to say whether this is a recurrence without a microscopic examination.

THE MATAS OPERATION FOR ANEURISM*

REPORT OF PERSONAL CASES

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In a previous paper † I reviewed seven cases of this kind. Two additional cases have followed, which I have thought of sufficient interest to report, with a tabulation and summary of the total of nine cases.

Case VIII.—E. J., male, mulatto, aged thirty years, porter. Admitted to Charity Hospital, New Orleans, December 2, 1922; discharged February 26, 1923. This man complained of a swelling in the back of the right knee. Previous history negative except for venereal sore twelve years ago; Wassermann test positive. For the past six months he has been conscious of a small throbbing tumor in the right popliteal region with pain radiating down the back of the leg to the ankle. On examination of the region complained of, inspection and palpation showed an expansile tumor about three inches by two inches; auscultation revealed a soft systolic blow. A characteristic sign of aneurism—absence of pulsation in the dorsalis pedis and posterior tibial arteries—was observed. The Matas test of collateral circulation showed return of color in from four to five minutes. In preparation for operation neoarsphenamin and potassium iodid were given. To improve the circulation the Massachusetts General compressor was applied daily for 10 to 45 minutes; the electric bath was applied and digitalis administered.

Operation was done January 15, 1923, Dr. Rudolph Matas acting as consultant. Spinal anæsthesia was employed, two grains of apothesin being injected between the eleventh and twelfth thoracic vertebræ. After application of the Esmarch bandage and constrictor the sac was exposed and incised in the mid-line. About one and one-half ounces of firm, mixed clot were removed. The afferent opening was readily exposed on the floor of the sac about one inch from the upper pole; the efferent was found at the extreme lower pole. Both were closed with a double row of continuous paraffin silk sutures. On loosening the constrictor, blood escaped at both openings. The loss from the distal end was profuse, showing good collateral circulation. Both lines of suture were reënforced. On removal of the constrictor the foot assumed a hyperæmic color. The cavity was obliterated by plication with catgut sutures. Buried catgut sutures for muscles and fascia were used. The skin was closed with interrupted sutures of silkworm gut and linen. After the usual aseptic dressing the limb was wrapped in cotton wadding and encased in a regular aneurism mattress pad (Matas). Aseptic healing followed. The convalescence was uneventful except for pain resulting from the spinal puncture. Observation of the case continued for several months after discharge, during which there were no new developments.

Case IX.—L. C., colored, male, aged thirty-eight years, laborer. Admitted to Charity Hospital, September 3, 1923, discharged November 20, 1923. His complaint on admission was swelling of left thigh, weakness of left knee and hip-joints. Previous history: Alcoholic indulgence; chancre denied. Wassermann test was negative. Two and a half months ago he was stabbed in the thigh with a pocket knife. There was profuse bleeding at the time. For a week he was unable

* Read before the Southern Surgical Association, December 11, 1923.

† New Orleans Medical and Surgical Journal, vol. lxvii, pp. 598–607.

to use the leg, which was quite swollen, though not as large as it was later. About four weeks after the injury while the patient was walking, the limb began to swell and assumed the proportions seen at the time of admission.

Examination showed a smooth, rounded swelling in the second fourth of the thigh from the groin, encroaching on the third fourth; it extended transversely so as to cover the ventral and mesial surfaces, eight inches in long diameter, 10 inches in transverse. Inspection showed pulsation straight up and down, none in a transverse direction. Palpation revealed thrill beginning centrally to the mass and extending along the line of the femoral vessels to a point distal to the mass. Elsewhere over the mass there was arterial pulsation only. There was a systolic bruit all over the mass, superimposed on a steady hum which was heard best over the vessel line, where thrill was palpated; this hum was especially marked opposite the knife wound scar, which was at the junction of the ventral and lateral surfaces a little above the middle of the thigh. Central to the mass there was a peculiar systolic bruit, somewhat musical.

On these data a diagnosis of arterial varix was made, the signs being interpreted as showing a direct communication between artery and vein, without any intervening aneurismal sac. As might be expected, pulsation in the dorsalis pedis and posterior tibial arteries was less vigorous than on the opposite side. A curious observation was that of the blood-pressure in this case. There was some difference between the two brachials, the right registering 108–60, the left 92–50. The pressure just above the patella was 120 systolic on the normal side, only 80 on the affected side. This was to be expected on account of the diversion of a part of the arterial blood into the vein. But a strange and inexplicable observation made in this connection was that while the pressure at the groin on the normal side was 140–70, that just above the swelling on the affected side ranged from a systolic reading of 240 mm. down to 0, the arterial beat being heard when no pressure was recorded by the manometer. This observation confirmed an independent reading by the interne of the service.

It is a well-known fact that arteriovenous aneurism in some cases exists for a long time without doing any harm. In this case there was not a network of large distended veins associated with signs of bad nutrition, such as we observe at times, but the exposed situation of the lesion, in a man who earned his living by rough work, caused operation to be decided on.

This was done September 18, 1923, under ether anæsthesia. After elevation of the limb, a rubber tube was applied at the groin for hæmostasis. A right-angled flap was marked out through the skin, its base lateral, the extremity median to the line of the vessels. The sartorius was freed and cut across at the lower angle of the wound. Hunter's canal was opened and the femoral artery exposed and traced up to about two inches distal to Poupart's ligament. This was done with some difficulty because the tissues were abnormally adherent. The vein was not seen. At the level mentioned, while tissues were being separated with the handle of the scalpel on the median side of the artery, a venous cavity was opened, which bled freely, despite the rubber tube constriction, and had to be packed. This was the median and smaller portion of the dilated vein, which extended from here posteriorly to the artery and projected on its lateral side. This arrangement had not been recognized in the previous study of the case. The arterial opening, which was in the common femoral artery, just above the bifurcation, was a slit nearly one-fourth of an inch long. This was closed by continuous lateral arteriorrhaphy, using fine silk drawn through sterile vaseline, on a round curved needle. The lumen of the artery was noticeably diminished. The opening in the venous sac was enlarged and the afferent or distal orifice whipped over with silk from within, the central orifice not being identified and not causing any trouble through hemorrhage.

TABLE I.

Name	Age	Occupation	Race	Diagnosis	Treatment	Gangrene	Hemorrhage	Recurrence	Remarks	Reference
1. G. D.....	32	Brick-mason	Mixed	Fusiform aneurism, right popliteal artery, lower two-thirds	Intrasaccular suture (obliterative endoaneurismorrhaphy Matas)					ANNALS OF SURGERY, vol. xli, pp. 115-117.
2. C. W.....	22	Laborer	Negro	Arterial varix of right femoral artery and a vena comes; sequel of gunshot wound	Incision of vein, suture of opening in artery. (Modified Matas-Bickham technic) (Restorative)					N. O. Med. and Surg. Journal, vol. lx, pp. 553-556.
3. F. L.....	29	Painter	Negro	Fusiform aneurism, right popliteal artery, middle portion	Intrasaccular suture (obliterative endoaneurismorrhaphy Matas)				No recurrence after four years (1911)	N. O. Med. and Surg. Journal, vol. lx, pp. 590-592.
4. R. W.....	21	Laborer	Negro	Varicose aneurism right profunda artery and vein, sequel of gunshot wound	Intrasaccular suture (obliterative endoaneurismorrhaphy Matas)				Patient died of erysipelas 18 days after operation	N. O. Med. and Surg. Journal, vol. lxi, pp. 531-533.
5. P. S.....	53	Swamper	Mixed	Fusiform aneurism, right iliofemoral region	Intrasaccular suture (obliterative endoaneurismorrhaphy Matas)				Patient died of multilocular prostatic abscess 43 days after operation	N. O. Med. and Surg. Journal, vol. lxii, pp. 631 633.

6. T. W.....	25	Not recorded	Negro	False aneurism, left femoral artery, following gunshot wound	Incision of false aneurism (restorative endo-aneurismorrhapy Matas)				Permeability of vessel not preserved	Southern Med. Journal, vol. v, p. 306
7. J. M.....	36	Laborer	Negro	Varicose aneurism of right femoro-popliteal vessels, following gunshot wounds	Intrasaccular suture (obliterative endo-aneurismorrhaphy Matas)				Operated on 9 years ago; still well (Jan, '24)	N. O. Med. and Surg. Journal, vol. lxvii, pp. 598-607.
8. E. J.....	30	Porter	Mixed	Fusiform aneurism of right popliteal, lower portion	Intrasaccular suture (obliterative endo-aneurismorrhaphy Matas)				Operated on one year ago; still well (Jan., '24)	
9. L. C.....	38	Laborer	Negro	Arterial varix of left common femoral vessels	Lateral suture of artery; intrasaccular suture of venous sac				Permeability of artery preserved	

Sac wall from both median and lateral venous pockets was brought over and sutured around the artery at the level of its sutured opening so as to reënforce this area and make hemorrhage less likely. A silkworm drain was placed in the lateral sac. The sartorius was sutured with No. 2 chromic, the skin with linen. The aneurism mattress pad of Matas was placed around the limb. September 20th, two days after the operation, pulsation could be felt in the dorsalis pedis artery. The circulation of the limb appeared entirely satisfactory.

November 5th, the dorsalis pedis pulsation was again recorded as present. It would appear that the lumen of the artery, though lessened by the lateral suture of the knife-slit, remained open. The patient was discharged on November 20th in excellent condition.

As indicated above the lesion was a direct communication between the common femoral artery and vein, the latter spreading out transversely so as to present a smaller median and a larger lateral sac.

Two observations, the explanation of which is not at hand, are the extreme high and low ranges of the blood-pressure above the varix and the absence of hemorrhage from the central end of the dilated common femoral vein. It is also worthy of note that the obliteration of the common femoral vein almost at the groin was followed by no circulatory disturbance. Such a closure, when no opportunity for adjustment has been afforded, is very apt to be followed by moist gangrene. The period which elapsed between the injury and the operation probably permitted collateral circulation to be built up, this being promoted by the increased pressure in the vein.

My personal series of aneurism cases operated on by the intrasaccular method of Matas (including these cases) may be tabulated as follows:

In all there were 9 patients, twenty-two to fifty-three years of age, all of negro descent, 3 mixed, 6 unmixed.

Of the aneurisms 4 were fusiform, 1 false, 4 arteriovenous; of the latter 2 were varicose aneurisms, 2 arterial varices.

Of the 9 cases, four (the one false and three arteriovenous) were due to gunshot injury; one to stab wound.

Five obliterative operations were done, 4 restorative, and no reconstructive.

No gangrene, no hemorrhage, no recurrence has been observed up to this time.

There was no mortality attributable to the operation, though one died of erysipelas eighteen days after operation, the infection being derived from another case adjacent to the patient in the ward, while a second died of multilocular prostatic abscess forty-three days after operation. A feature of this case was the fact that the diagnosis was not made in life, nor even on post-mortem examination, the fatal condition being discovered only when the pelvis was bisected by Professor E. Souchon for the purpose of preserving the specimen of obliterated aneurism.

AN IMPROVED METHOD OF REMOVING HERNIA FROM WITHIN*

By G. Paul LaRoque, M.D.

of Richmond, Va.

The operative story of abdominal hernia is characterized by conspicuous evidence of much thought and effort devoted by surgeons to plastic operative procedures and repair of muscles and fascia in the region of hernia—proce-

Fig. 1.—After dividing the skin, superficial fascia and aponeurosis, the muscle bundles of the internal oblique about an inch above their margin, are separated making a good exposure of the peritoneum well above the neck of the sac. The contents of the inguinal canal, the rectus sheath, conjoined tendon, the internal oblique, nerves and shelving edge of Poupart's ligament are plainly seen.

dures adaptable to the second stage of the operation after the first purpose, removal of the hernia, is completed.

Emphasis upon the necessity of high ligation of the neck of the sac and

* Read before the Southern Surgical Association, December 13, 1923.

of discovering combined direct and indirect (pantaloon or saddle bag) inguinal hernia, the utility of inguinal approach to femoral hernia; these are evidences of progress directing attention to the importance of finding and removing all the sac.

Ample demonstrations at second operations have shown that failure at the first attempt to cure hernia has been incident quite usually to incomplete removal of all the sac and redundant peritoneum which existed at the time of the first operation, or of unintentional anchorage of the ligated or sutured neck to the tissue into which it was pulled down for excision at the first

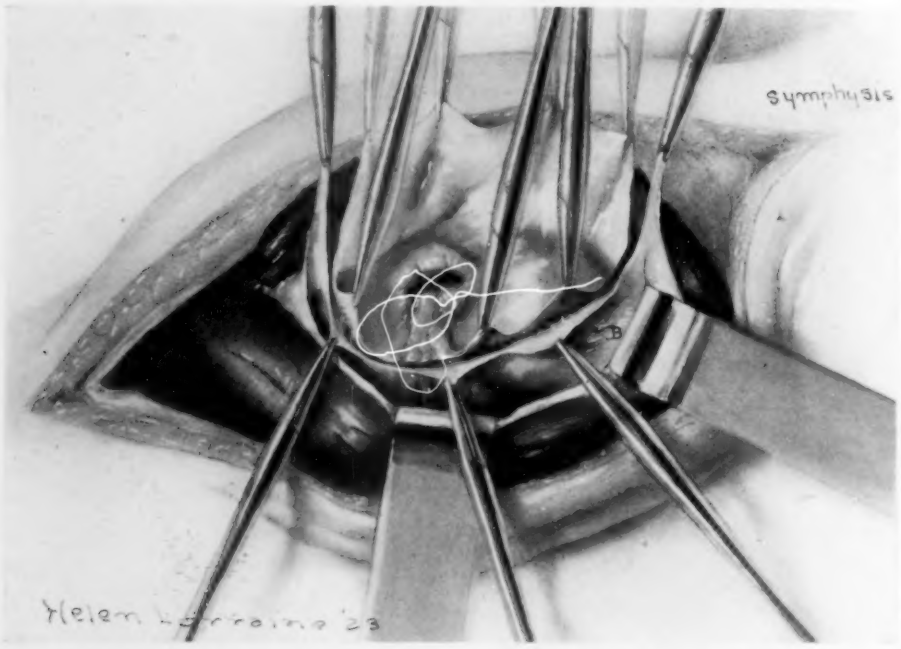

FIG. 2.—The peritoneum opened, the whole region of hernia exposed and the redundant peritoneum of the area incised and about to be freed over a wide area preliminary to enucleation of the sac. Bladder at B, vessels and vas deferens plainly seen and felt through peritoneum.

operation. (We are not considering post-operative incisional rupture, a sequel to suture breakage and wound suppuration.)

Permanent cures of herniæ are seen with great frequency after excision and high ligation or suture of the neck of peritoneum followed by less ingenious, if not crude methods of canal repair by less skillful operators. Voices of great respectability [1] within recent years are giving expression to the belief that high removal of the neck of the sac is the most, if not the only essential procedure of the operation for the cure of ordinary indirect inguinal hernia of small or moderate size in children, women and young men: though for direct and indirect hernia of large size in individuals with imperfect or absent conjoined tendon, plastic operations and suture of certain fascial structures are useful additional measures. The recent work of Seelig and Chouke [2] showing the stay of muscle sewed to fascia to be quite temporary, supplies additional

reason for the belief that much credit for the cure of hernia must be assigned to high removal of the sac.

And as we read the story and witness the performance we see little evidence of conspicuous improvement upon the old process of digging in, scrubbing out, pulling down and finally tying off the sac from below and in front, upward and in other directions. This at best is a non-gentle if not crude process and sometimes looks like rough handling, in comparison with gentle, refined, technical procedures of other surgical operations.

It is, therefore, quite natural for one to inquire if there may not be room for improvement upon the method of approach to, and excision of, the sac

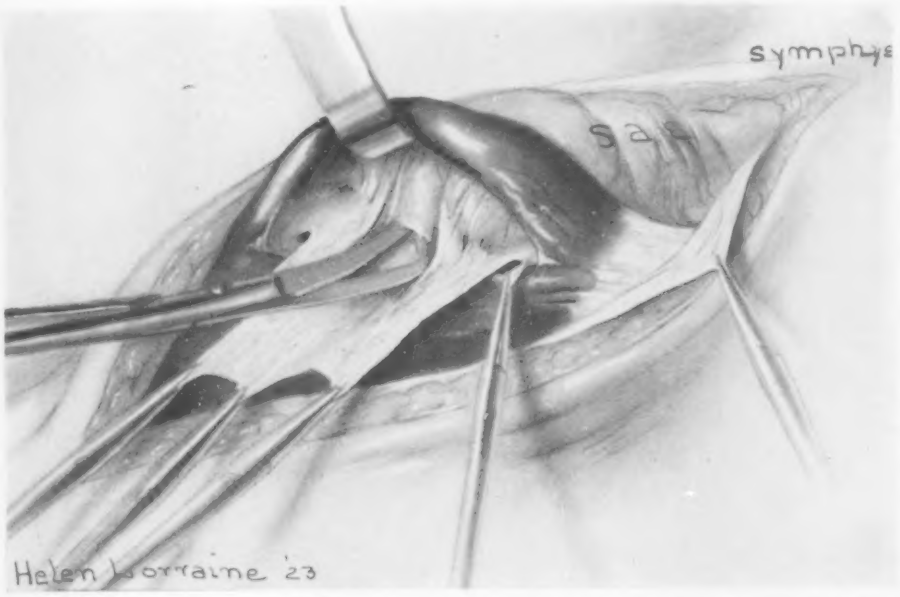

FIG. 3.—The lower edge of incised peritoneum held flat and pulled upward, is easily separated by blunt blade scissors inserted into the space of easy cleavage between the peritoneum and infundibuliform fascia.

and redundant peritoneum about its neck and of closure of the peritoneum well above the hernial orifice, the first and essential purpose of any method of cure of hernia.

And finally with our present day conception of hernia as a definite anatomic structure (a peritoneal sac) of congenital, prenatal or post-natal origin, it should be possible by means of a method permitting adequate open exposure of the entire region of operation, to remove successfully all of every hernia and its adjacent redundant peritoneum, employ needful plastic procedures as a part of wound closure and be assured at the conclusion of the operation that the hernia is permanently cured, and that unless serious wound infection or suture breakage should occur, post-operative rupture will not follow.

In 1919[3] and 1922,[4] I published two papers illustrating a method of complete removal from within the peritoneal cavity, avoiding most of the

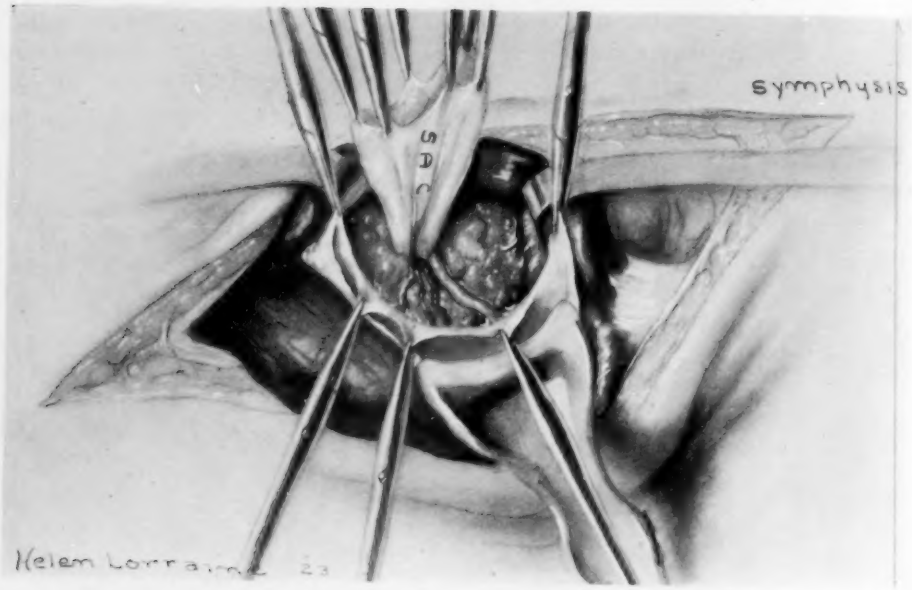

FIG. 4.—The sac and adjacent peritoneum being pulled up, is easily separated from the vessels, vas deferens and fascia of the cord in easy view.

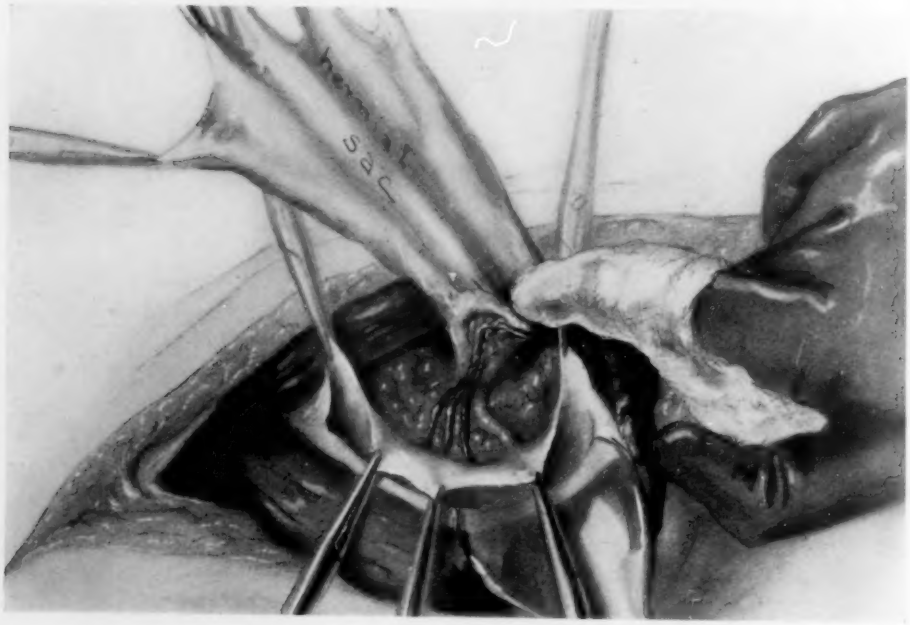

FIG. 5.—The sac almost removed.

well-known dangers, difficulties and disagreeable consequences incident to sac removal from without, and making the operation much more certain and easy of accomplishment. In this way I have operated upon more than 500 cases with progressive ease and satisfaction. During the past two or three years this method of enucleation of the sac and suture of the peritoneum has been distinctly improved and is now accomplished in the way herein illustrated. I first saw the advantage of the improved method in enucleating the sac of hernia associated with undescended testicle, and of anomalous types of sac, and now employ it routinely in all cases of hernia.

The usual incision is made through the skin, superficial fascia and aponeurosis of the external oblique, exposing the lower portion of the internal

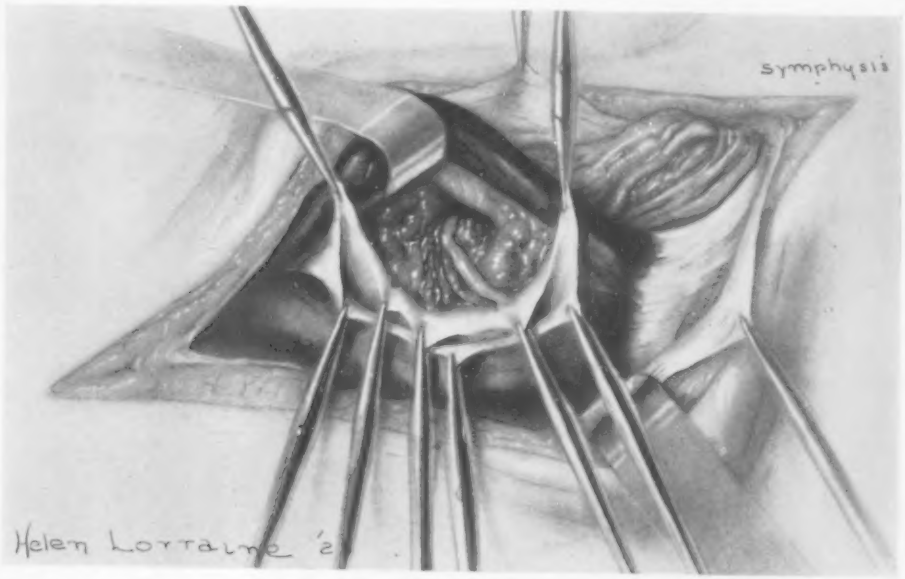

FIG. 6.—The sac now entirely removed, the edges of the incision in the peritoneum are held ready for suture. The peritoneum is easily freed from areolar tissue if necessary to do so, to suture without tension.

oblique, edge of the rectus, the contents of the inguinal canal and the shelving edge of Poupart's ligament (Fig. 1). After separation of a bundle of fibres of the internal oblique and transversalis about an inch above their lower margin, the peritoneum above the hernia is exposed and opened (Fig. 2). Bowel and omentum incarcerated in the sac and adherent above, may be safely and adequately separated and such operations as excision of omentum, bowel work and needful operations upon the pelvic organs performed. The hernial neck, adjacent peritoneum and position of the urinary bladder are now adequately exposed. The sites and exact types of indirect and direct inguinal, femoral, anomalous and combined herniæ, and the exact condition of such structures as the conjoined tendon, transversalis fascia, etc., are determined. The vas deferens, vessels of the cord, urinary bladder and large vessels covered by parietal peritoneum are exactly and easily identified. When needful to

release incarcerated bowel, omentum and other organs within the sac its neck may be cut or stretched from within exactly at the desirable spot with no danger of cutting other structures, without downward traction and consequent danger to the blood supply, permitting immediate reposition of bowel into the peritoneal cavity and more prompt restoration of circulation to areas of bowel threatened with gangrene. Traction upon the lower edge of the peritoneal incision by forceps placed near the bladder and well external to the position of the internal hernial ring, hold taut the redundant peritoneum which is now ready to be cut away (Fig. 2). The posterior portion of the pelvic peritoneum well above the neck of the sac is easily picked up by forceps, cut,

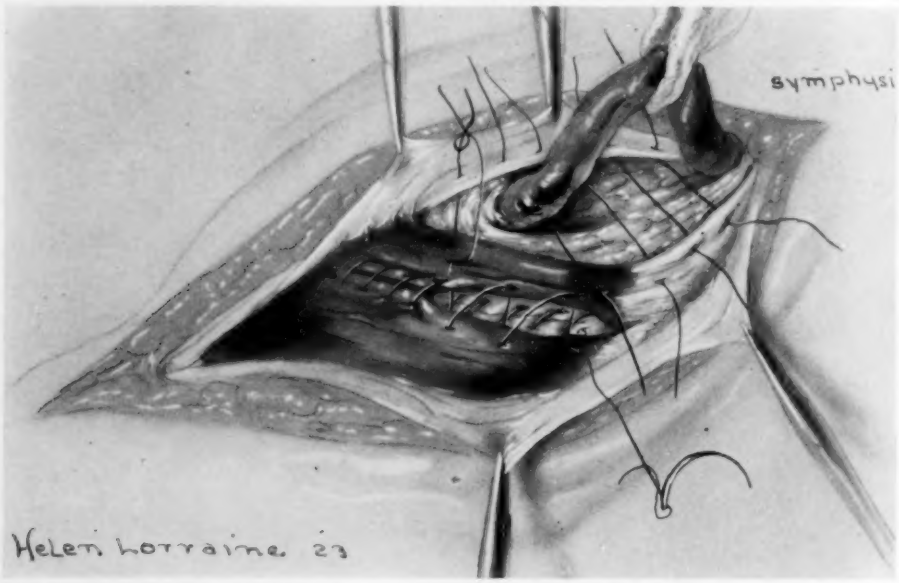

FIG. 7.—The peritoneum is sutured to a position much above the hernial orifice each suture catching the transversalis muscle and its fascia when present; the separated bundles of internal oblique are sutured and finally the canal may be closed in whatever method seems best in the individual case.

and freed from underlying areolar tissue always as far inward as the bladder and outward well beyond the internal ring. This part of the peritoneum lifted by gentle traction away from its underlying areolar tissue is freed by blunt scissors enucleation with surprising ease. I have not encountered intimate adhesions of the peritoneum to the vessels or the vas deferens in this location. The anterior or lower portion of the parietal peritoneum is now held taut and flat by gentle traction upon the lower edge of the original incision into the peritoneal cavity (Fig. 3). Blunt scissors are then inserted into the space between the peritoneum and the infundibuliform or cremasteric fascia where a natural line of cleavage exists. With gentle traction and blunt scissors or knife-handle separation, the hernial sac is readily enucleated (Fig. 4) in the natural direction "with the grain" from beneath and with minimum trauma to the fibres and fascia of the cremaster, internal oblique and other muscles

which may be utilized in wound closure. With the urinary bladder, vas deferens and vessels of the cord continuously in view and the sac being continuously pulled away from them, these structures are gently brushed away (Fig. 5) as enucleation proceeds and are at all times quite safe from injury. Commonly there are only three points of intimate contact, namely the vas at the neck of the hernia, the bladder at the point of peritoneal attachment, and the deep epigastric vessels in front. The latter, if adherent, may easily be tied and cut; the vas deferens need not be much traumatized, the bladder is not likely to be injured. In some cases, especially in those who have worn trusses or who have been previously operated upon, and occasionally in others, the adhesions of the sac to the fascia may make separation less easy. Once in a while the lowermost portion of the sac may be intimately related to the testicle or epididymis, but in no case is the difficulty of enucleation in this way equal to that encountered in the old way in freeing the sac from without and below upward. With the entire sac and adjacent peritoneum in all directions removed, careful inspection of the field is made (Fig. 6). If one chooses to do so, the internal orifice of the canal may be sutured. I have not done so. The peritoneum may easily be mobilized and sutured without tension. By beginning the suture at the inner end near the bladder and catching with the peritoneum whatever transversalis fascia may exist or some muscle, the wound is closed quite like that of any other muscle splitting abdominal incision (Fig. 7), and at a position much higher and further removed from the hernial ring than is likely to be the case after suture and ligation from below.

Needful plastic procedures may now be employed, the wound closed by whatever method seems best for the individual case and one is quite able to know at the conclusion of the operation without having to wait months or years to determine, that the hernia and loose adjacent peritoneum are completely removed, and the peritoneum smoothly sutured high above the orifice and canal of the herniated sac.

REFERENCES

[1] Halsted: Quoted by Taylor. Archives of Surgery, Sept., 1920.
[2] Seelig and Chouke: Archives of Surgery, Nov., 1923.
[3] LaRoque: Surg., Gyn. and Obstetrics, Nov., 1919.
[4] LaRoque: ANNALS OF SURGERY, Jan., 1922.

THE INFLUENCE OF HEMORRHAGE ON THE MORTALITY IN GUNSHOT WOUNDS AND OTHER INJURIES OF THE ABDOMEN*

A SUPPLEMENTARY REPORT WITH ANALYSIS OF 127 CASES

By James Monroe Mason, M.D.
of Birmingham, Alabama

At the 1922 meeting of the Southern Surgical Association I presented a paper with the above title, reporting 69 abdominal injuries with a gross mortality of 59.4 per cent. This paper was published in Annals of Surgery, September, 1923.

Long observation had convinced me that this very high mortality was due not so much to the result of the visceral injuries as to the hemorrhage which was so often associated with them. The cases were, accordingly, subdivided into two groups, those with large hemorrhage, and those with small hemorrhage. In the large hemorrhage group, with extensive visceral injury were 37 cases; 34 deaths, 3 recoveries, mortality 91.8 per cent. In the small hemorrhage group, with extensive visceral injury were 19 cases; 6 deaths, 13 recoveries, mortality 31.5 per cent. Both groups were operated on promptly, by the same surgeons, in the same hospitals; and, as shown by one of the tables presented last year, received the same general type of visceral injury. The difference in the mortality rate was clearly demonstrated to be due to the amount of hemorrhage present.

It was pointed out that the usual methods of combating hemorrhage were unavailing, and that nearly all the patients in the large hemorrhage group died quickly from loss of blood, before sufficient time had elapsed for inflammatory or other complications to develop. It was insisted that these patients must be transfused if we hoped to reduce this mortality, and a plea was made for a systematic attempt on the part of every hospital organization to procure donors for these patients, and to make transfusion as much a part of the treatment as the laparotomy, in the " large hemorrhage " group.

I reported the case of a patient with ruptured spleen with enormous hemorrhage and a systolic blood-pressure of 66, who would have surely died if he had not been transfused, but who, after transfusion, was so much improved that splenectomy was successfully performed, and he recovered.

During the past year I have had the opportunity of observing the results of 58 cases of gunshot and stab wounds of the abdomen in St. Vincent's Hospital, the Hillman Hospital, and the Employees' Hospital of the Tennessee Coal, Iron and R. R. Co., the same institutions from which I obtained the statistics for my 1922 paper. Seven of these cases have been in my own service; fourteen in Dr. Lloyd Noland's clinic at the Employees' Hospital, and the remaining thirty-six, in the services of my associates, Doctors Talley, Ledbetter, Drennen, Moore, McCrossin, Leland, Lester, Solomon, Magruder, Davis, E. P. Hogan and G. A. Hogan, at St. Vincents' and Hillman Hospitals.

* Read before the Southern Surgical Association, December, 1923.

I have subdivided these cases into "Large Hemorrhage" and "Small Hemorrhage" groups in the same manner as was adopted in the series reported in 1922. I have also made a similar analysis of the combined group, 127 cases, as against 69 cases in my former paper, in order to emphasize by the greater number of cases the points presented in the previous paper, in an endeavor to strengthen the plea for transfusion, and thereby to reduce the high mortality of the large hemorrhage series.

The results in this year's series of 59 cases are practically parallel with those of last year, and the combined statistics in the 127 cases vary but little from those previously presented.

For the total series we have the following figures:

TABLE I

	1922	1923	Combined
Crushing injury (rupture of spleen)	1	..	1
Stab wounds	9	9	18
Gunshot wounds	59	49	108
Total cases	69	58	127
Deaths	41	33	74
Mortality rate	59.4	56.7	58.2

TABLE II—1922

Group No. 1—Large Hemorrhage Series

A—Cases not operated on by reason of collapse from hemorrhage when admitted:

		Cases	Deaths	Mortality per cent.
Gun shot wounds	9	..	..	..
Stab wounds	1	10	10	100

B—Operative cases; large hemorrhage with extensive visceral injury:

Gunshot wounds	24	..	..	..
Stab wounds	2	..	..	..
Crush injury	1	27	24	88.8
Total		37	34	91.8

Group No. 2—Small Hemorrhage Series

A—Operative cases; no material hemorrhage, extensive visceral injury:

		Cases	Deaths	Mortality per cent.
Gunshot wounds	17	..	..	..
Stab wounds	2	19	6	31.5

B—Explorations; wounds non-penetrating (5) or penetrating with no visceral injury (8):

Stab wounds	9	..	..	..
Gunshot wounds	4	13	1	7.6
Total		32	7	21.8

TABLE III—1923

Group No. 1—Large Hemorrhage Series

A—Cases not operated on by reason of collapse from hemorrhage when admitted:

		Cases	Deaths	Mortality per cent.
Gunshot wounds	5	5	5	100
B—Operative cases, large hemorrhage, extensive visceral injury:				
Gunshot wounds	16	..	..	..
Stab wounds	4	20	17	85
Total		25	22	88.8

Group No. 2—Small Hemorrhage Series

A—Extensive visceral injury; no material hemorrhage:

		Cases	Deaths	Mortality per cent.
Gunshot wounds	23	..	..	..
Stab wounds	5	28	11	39.8
B—Explorations: wounds non-penetrating (3) or penetrating without visceral injury (2):				
Gunshot wounds	5	5	0	0
Total		33	11	33.3

COMBINED STATISTICS 1922 AND 1923 CASES

TABLE IV

Group No. 1—Large Hemorrhage Series

A—Cases not operated on by reason of collapse from hemorrhage when admitted:

		Cases	Deaths	Mortality per cent.
Gunshot wounds	14	..	..	..
Stab wounds	1	15	15	100
B—Operative cases—Large hemorrhage; extensive visceral injury:				
Gunshot wounds	40	..	..	..
Stab wounds	6	..	..	..
Crushing injury	1	47	41	87.2
Total		62	56	90.3

Group No. 2—Small Hemorrhage Series

		Cases	Deaths	Mortality per cent.
A—No material hemorrhage; extensive visceral injury:				
Gunshot wounds	40	..	..	..
Stab wounds	7	47	17	36.1
B—Explorations—wound non-penetrating (8) or penetrating with no visceral injury (10):				
Gunshot wounds	9	..	..	..
Stab wounds	9	18	1	5.5
Total		65	18	29.2

The extreme difficulty encountered in obtaining donors for the class of patients composing this series still exists. In my own cases no large hemorrhage occurred, so the necessity for transfusion did not present itself to me in my 1923 work.

Only one transfusion is recorded in the 1923 series; a case operated on by Dr. S. L. Ledbetter, Jr. This case serves to demonstrate, as did my transfusion in ruptured spleen reported last year, the wonderful effect of transfusion on a patient doomed, without it, to a speedy death.

The details, in brief, are as follows: The patient, a colored male, age twenty, was shot by an officer, November 13, 1923, at 10.50 P.M. He was admitted to the Hillman Hospital at 11.15 P.M., and was operated on November 14, 12.25 A.M., one hour and thirty-five minutes after being wounded.

Laparotomy revealed two perforations of stomach which were sutured and a perforating wound of the liver, which also was sutured and drained. The abdomen was full of blood. The pulse became so rapid and weak that the patient almost died on the table, and further search for injuries was abandoned. The patient received 750 c.c. of salt solution intravenously, and other stimulants, but did not improve. At 3 A.M. a donor was obtained and a transfusion of 500 c.c. of blood was given. He rallied at once and made an uninterrupted recovery.

CONCLUSIONS

To secure a reduction in the mortality rate of the small hemorrhage series, which stands at 36.1 per cent. where there is visceral injury, we must depend upon early operation; refinement of surgical technic; lessening the shock of prolonged ether anæsthesia by a more extensive use of local anæsthesia, nitrous oxide or ethylene anæsthesia, and the most careful attention to the details of after treatment.

To secure a reduction in the mortality of the large hemorrhage series, which stands at 87.2 per cent. in the operative cases, all the requirements above noted must be observed, and donors for transfusion must be obtained regardless of trouble or expense.

PARTIAL GASTRECTOMY FOR GASTROJEJUNAL ULCER*

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Section on Surgery, Mayo Clinic

The basic principle in the surgical treatment of peptic ulcer is adequate drainage of the stomach. Whether gastro-enterostomy, partial gastrectomy, or pyloroplasty is performed, the surgeon recognizes the necessity of a large

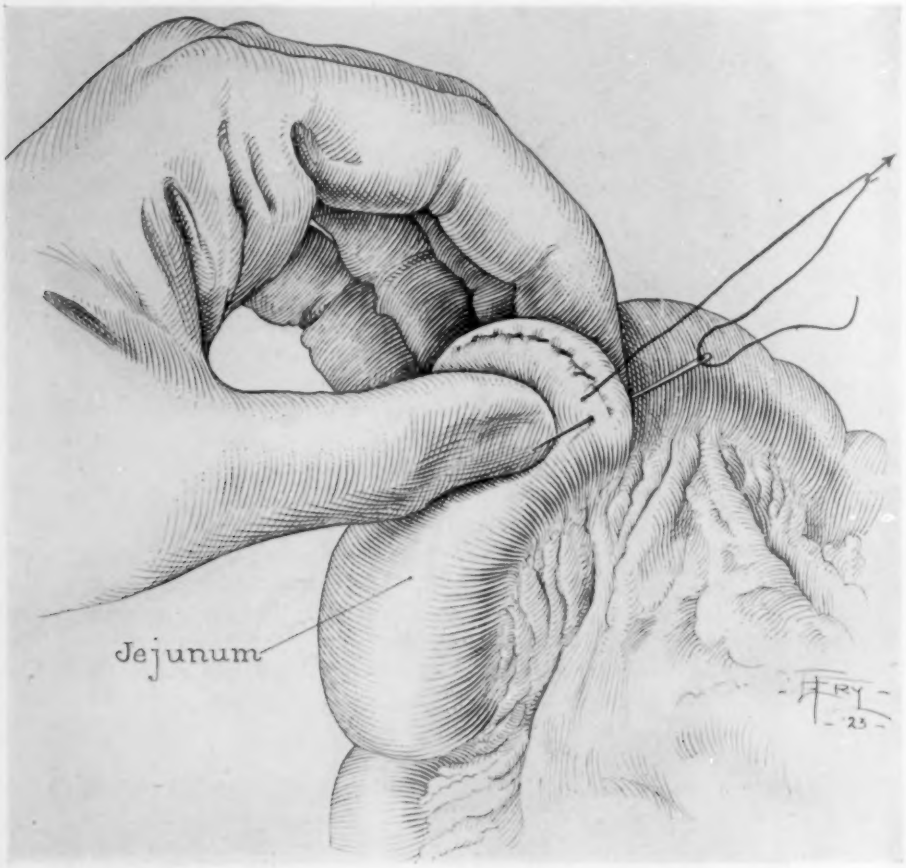

Fig. 1.—Continuous suture closing jejunum after it has been removed from the stomach.

and properly placed communication between stomach and small intestine. The efficiency of gastro-enterostomy, and its consequent popularity, are largely dependent on the excellent drainage provided by the properly performed operation. In duodenal ulcer, gastro-enterostomy, combined, when necessary, with excision of the ulcer, gives 95 per cent. of satisfactory results,

* Read before the Southern Surgical Association, December 11, 1923.

and a mortality rate between 1 and 2 per cent.; in gastric ulcer, if combined as a routine with cautery or knife excision of the ulcer, 90 per cent. satisfactory results and a mortality rate between 2 and 3 per cent. are obtained.

Failures under such management are seldom complete since those patients

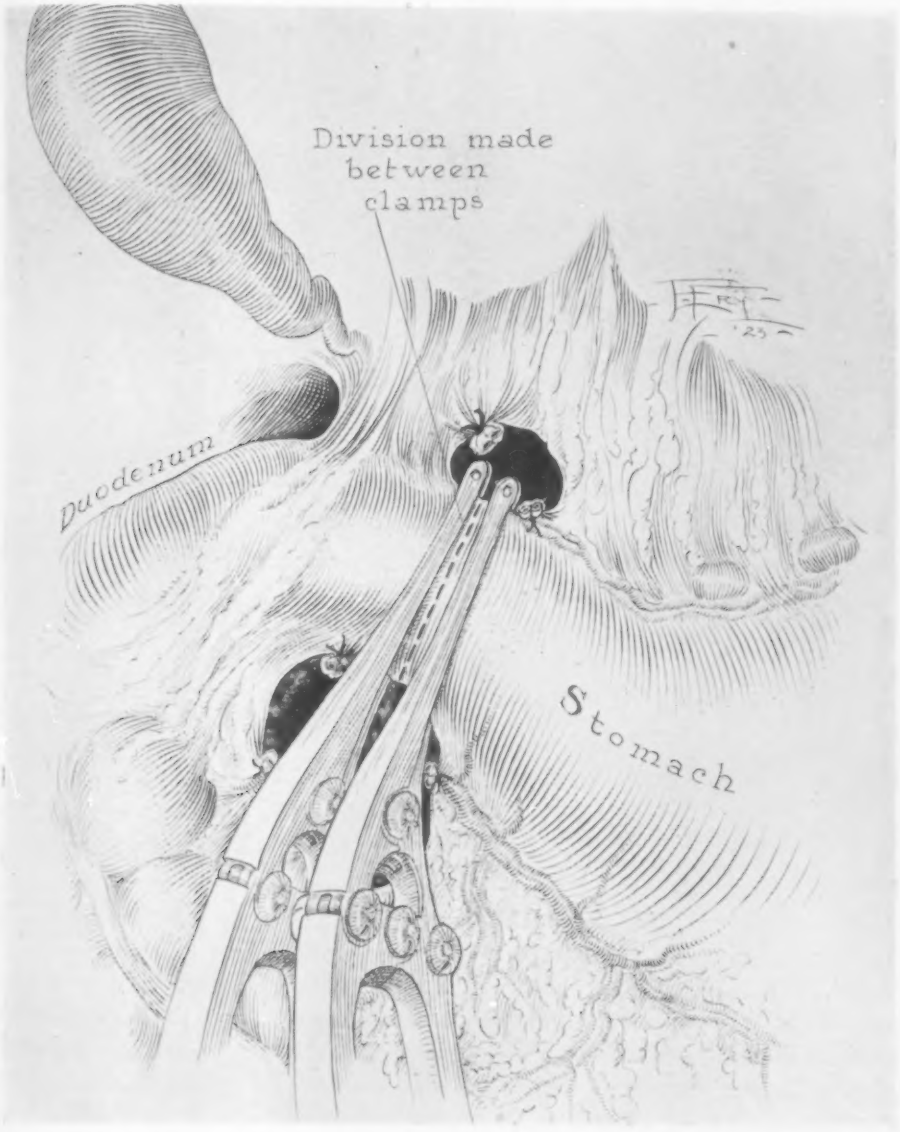

FIG. 2.—Two Payr clamps are placed on the pylorus, openings being made in the gastrohepatic omentum.

who do not consider the results satisfactory have usually experienced partial relief from their symptoms, and find it possible to control the slight digestive disturbances by dietary discretion and simple medication. The most serious sequel of gastro-enterostomy is gastrojejunal ulcer. It occurs apparently,

in about 2 per cent. of cases, which represents the average incidence in large series of gastro-enterostomies reported by different surgeons. The real cause, or causes, of the ulceration are not known, because when all the factors possibly concerned in its formation, such as persisting hyperacidity, errors in technic, neglect in post-operative care, unabsorbable sutures, unremoved foci of infection, are eliminated, ulceration may still occur. The cause of gastrojejunal ulcer, therefore, is as uncertain as is the cause of peptic ulcer.

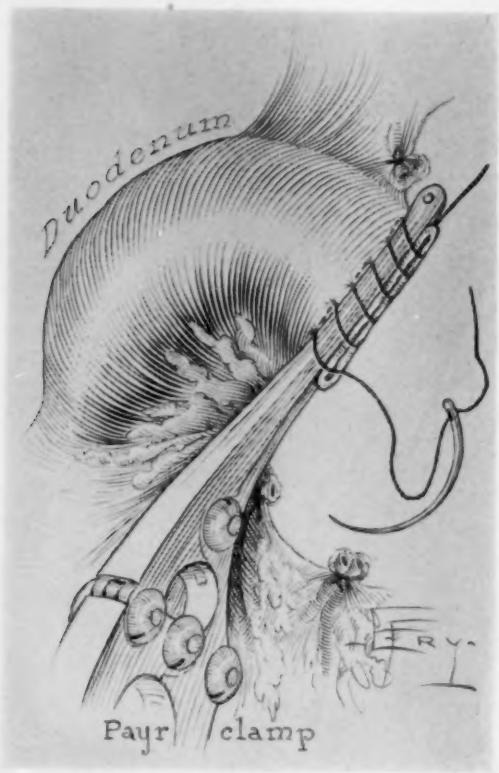

FIG. 3.—First suture placed in the duodenum. Suture passes through the anterior and posterior walls of the intestine and around the Payr clamp.

Gastrojejunal ulcer manifests itself in no uncertain manner, the symptoms are usually easily recognized clinically, and its presence can be confirmed by fluoroscopy. The patient experiences the usual good health and freedom from symptoms for from six months to one year. With the exception of the few cases in which the first symptoms are those of a complication, such as perforation, hemorrhage, or vomiting from obstruction at the stoma, the onset is gradual. Pain associated with the ingestion of food (usually one to two hours after meals) gradually appears and is resistant to ordinary measures of treatment. The pain is usually lower (often to the left of the middle line) than in peptic ulcer, and is of great diagnostic significance. It increases in severity, and may be accompanied by vomiting, which often gives temporary relief. The majority of patients seek surgical relief early. If any doubt remains whether an ulcer is present or not, fluroscopic examination will give positive information in more than 95 per cent. of cases. Since experience has shown that early surgical treatment is safe and satisfactory, operation should not be postponed, because a cure by medical means is extremely rare (Paterson says that 100 per cent. of patients not operated on die) and the lesion tends to progress in size, and in complications. Delaying operation means a patient in poor condition, an extensive lesion, a difficult and serious operation, and uncertain results.

The surgical management of gastrojejunal ulcer is varied, but it always necessitates an operation of considerable magnitude. In the Mayo Clinic,

168 gastrojejunal ulcers have been operated on, eighty-six of our own cases in a series of 6192 gastro-enterostomies, and eighty-two cases in which the original operations were performed elsewhere. The method of treatment has been either: (1) excision of ulcer, when small, with enlargement of the original anastomosis; (2) cutting off the gastro-enterostomy, excising the lesion, closing the openings in jejunum and stomach, and pyloroplasty; or (3) cutting off the gastro-enterostomy, excision of the lesion, closing the opening in the jejunum, resecting the pyloric end of the stomach, including the opening of the anastomosis, with restoration of continuity by whatever method is best suited to the case. The latter operation, partial gastrectomy, has such distinct advantages, particularly in its end results, that I bring it to your attention.

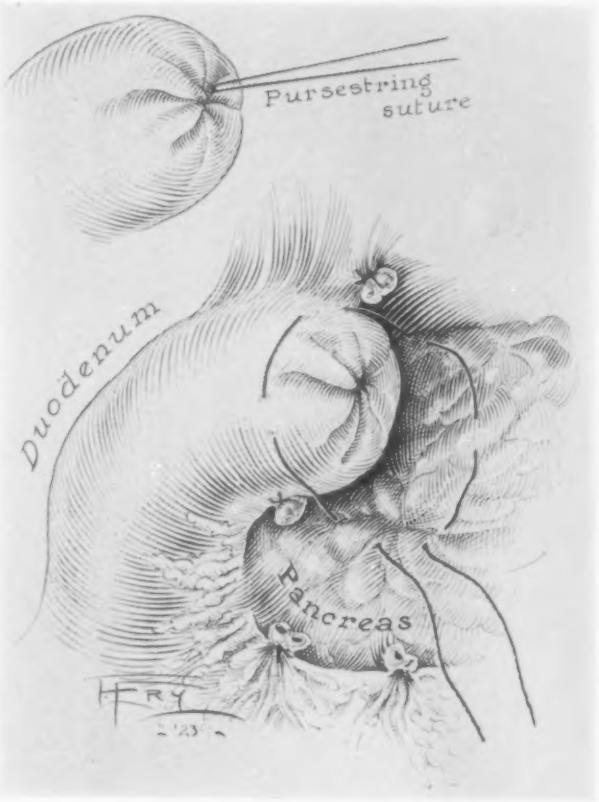

FIG. 4.—Purse-string suture in duodenum and pancreas to invert duodenal stump.

Patients with gastrojejunal ulcer, especially those with unusually severe symptoms, or with symptoms of long standing, are usually benefited by a course of pre-operative treatment. Hospitalization for a few days, during which time the stomach is kept at a minimum of activity, fluids given by rectum and hypodermaclysis, and, if there is marked anæmia, one or more transfusions, will bring the patient to a point of maximal improvement, and lessen the activity of the inflammation in the region of the lesion. Since the operation may be protracted, it is advisable that as much as possible should be performed under ethylene or local anæsthesia, preceded by morphin and atropin given one-half hour before operation. Exploration usually reveals the induration characteristic of the lesion in the anterior line of the anastomosis, and this induration varies in extent from a small area of the anastomosis to one involving the entire circumference of the anastomosis with extension to neighboring structures. The mesocolon is always involved,

the transverse colon occasionally, possibly with formation of a gastrojejunocolic fistula, and the anterior abdominal wall rarely. The anastomosis is first mobilized. This may necessitate separation from the colon, and if an opening is present in the latter, it is closed and protected as well as possible by omental tissue. If no opening can be demonstrated, but considerable necrosis of the wall of the colon has occured, this area of the bowel should be wrapped in omentum and a few sutures placed so as to maintain the protection. The

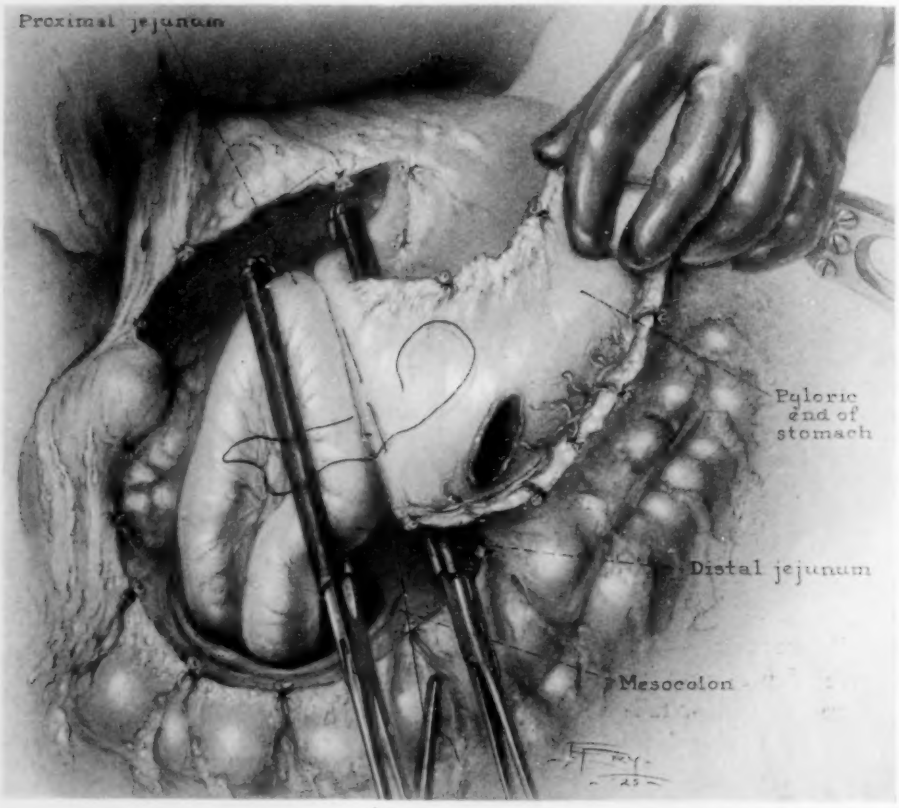

FIG. 5.—The first row, continuous serous suture, approximates jejunum and stomach. Old gastro-enterostomy opening on posterior wall of the stomach.

colon being disposed of, the anastomosis is inspected. If the induration is slight and is readily excised, this may be done and the anastomosis reconstructed on a larger scale. However, there is a growing tendency in the Clinic, even when lesions are small, to disconnect the anastomosis, excise any ulceration of the jejunum, close the opening in it, and perform partial gastrectomy. The basis for this radical procedure is the fact that if an operation, such as gastro-enterostomy, which prevents the recurrence of ulcer in more than 95 per cent. of cases, fails to prevent recurrence, it is because for some reason the patient has a very unusual liability to ulcer formation. Since the cause of this liability is unknown, it is logical to remove the portion

of the stomach in which ulcers usually occur. The anastomosis, then, is mobilized, and the actual union of stomach and jejunum exposed as clearly as possible. The anastomosis is encircled with the thumb and first two fingers of the left hand, and the line of anastomosis is cut across with large heavy

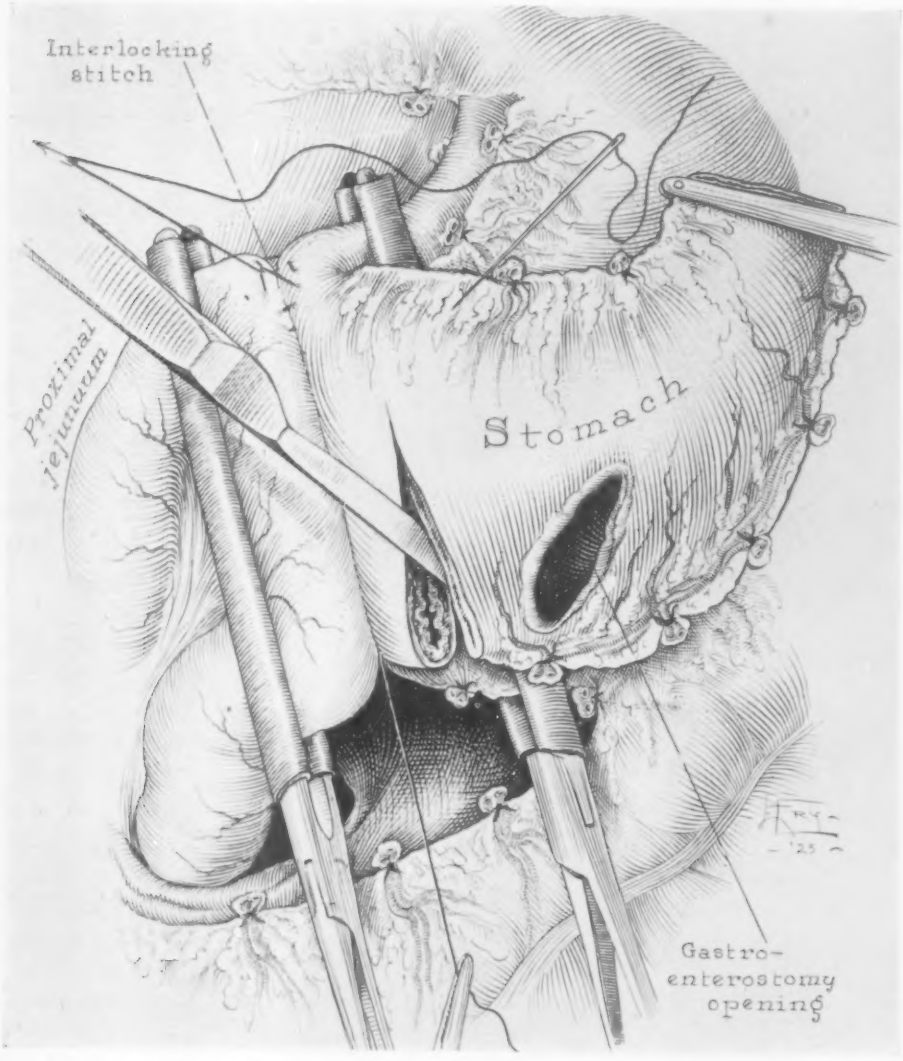

FIG. 6.—The pyloric portion of the stomach is resected distal to the suture line.

scissors, leaving, if possible, an excess of tissue on the jejunal side. The opening in the stomach is covered with a gauze pad, and the opening in the jejunum closed. This closure is made by two rows of continuous chromic catgut in a transverse direction, and the lumen is maintained during the closure by the thumb and first finger approximated under the suture line (Fig. 1). I have not seen obstruction take place at this point. The stomach is then

resected. The method recently described by Walton has certain advantages. The pyloric and the right gastro-epiploic vessels are first ligated, the pylorus divided, and the duodenum inverted (Figs. 2 and 3). If a lesion exists in the duodenum with fixation of the pylorus, it may be disregarded, and the stump of duodenum inverted in the usual way (Fig. 4). The pyloric end of the stomach is then mobilized by ligation in sections of the gastrohepatic omentum, and the gastro-colic omentum and the vessels along the lesser and greater curve ligated to a point 2.5 cm. beyond the line at which the resection is to be made. Ligation of the gastric artery is easier by this method than before the stomach is mobilized. A long rubber-covered clamp is placed as high as possible on the stomach, which is then turned over to the left (Fig. 5). If the resection is not to be too extensive, the jejunum is brought up through an opening in the mesocolon and a segment of it caught in a rubber-covered clamp and approximated to the stomach for an end-to-end anastomosis, the proximal end of the loop of jejunum being at the lesser curve of the stomach. The first suture line of chromic gut (seromuscular) now unites jejunum and stomach. When this has been placed, the operative field is well protected, and the stomach is divided on a line about 1.3 cm. from this suture line. This method of placing the first suture line before the stomach is cut away, prevents its retraction into a position where suturing would be awkward. The clamp still being on the stomach, hemorrhage from the cut end is partially con-

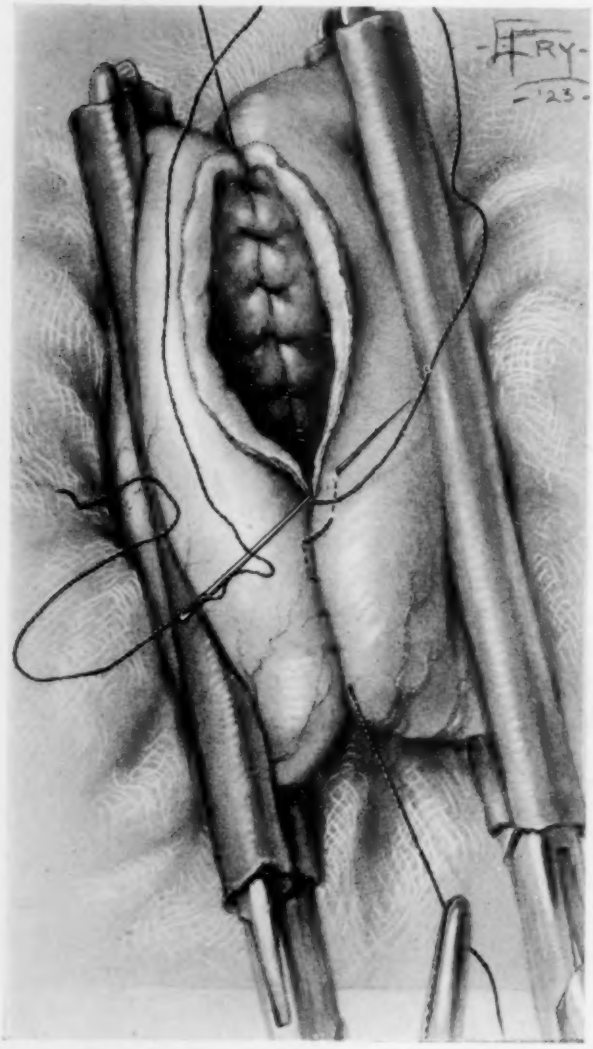

FIG. 7.—Continuous suture in anterior walls of jejunum and stomach. Suture passes through all coats.

trolled, the pocket of the open end is swabbed out, an opening of corresponding size made in the jejunum, and the anastomosis completed in the usual way (Figs. 6 and 7). Before the posterior aspect of the anastomosis has

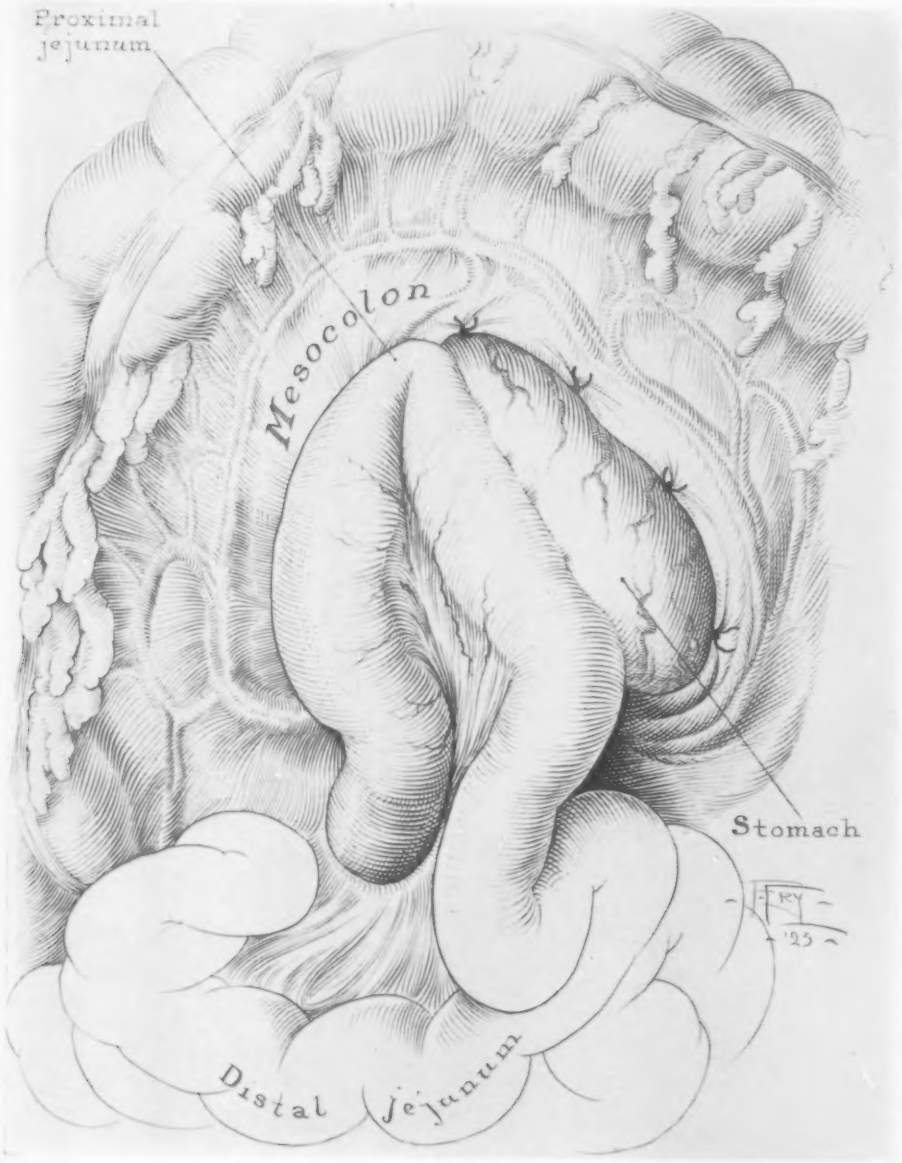

FIG. 8.—Completed operation viewed from under side of the mesocolon.

disappeared from view, the clamps on both jejunum and stomach are temporarily loosened, any oozing from the posterior suture line is controlled by a transfixing suture, and any vessels in the unsutured anterior edges which can be ligated are so dealt with. When the anastomosis is complete, one or

more tension sutures are placed at the lesser curve between jejunum and stomach to counteract any undue drag on the actual suture line at that point. The whole anastomosis is then drawn down through the opening in the mesocolon, and the edges of the latter structure are sutured to the stomach at as high a point as possible (Fig. 8). If the resection has been of sufficient extent to make a posterior anastomosis inadvisable or difficult, the jejunum may be brought up in front of the colon, and the anastomosis made as described.

We are finding increasing indications for partial gastrectomy for gastrojejunal ulcer, including its complications, colon fistulas, and so forth, and in twelve cases there has been no mortality. In view of the serious condition of many of these patients, the extensive inflammatory products in the operative field, and the fact that several operations had been performed on some of them, this is very gratifying. The results thus far have been excellent. I am convinced that partial gastrectomy is the operation of choice in the majority of such cases.

SURGERY OF RENAL TUBERCULOSIS*

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Tuberculosis is one of the most common and destructive of the surgical conditions of the kidney, an organ which apparently furnishes abundant soil, satisfactory for the location and growth of the bacillus of tuberculosis. In the early stages the lesion is small and well localized, and good results can be obtained from surgical procedures. Like pulmonary tuberculosis, now ordinarily recognized and provided for, renal tuberculosis often results in death. Wildbolz, in a series of 5338 necropsies, found that 158 (2.9 per cent.) of the deaths were due to renal tuberculosis. Schlesinger, in 2345 necropsy reports from the Berne Pathologic Institute, found renal tuberculosis in 5.3 per cent. of cases, in 20.7 per cent. of which there was pulmonary tuberculosis also. Hansen, in 462 fatalities due to tuberculosis, found that death was due to renal infection in 12.8 per cent. Kümmell gives a more favorable report; in only 119 (0.5 per cent.) of 40,621 necropsy reports from the Eppendorfer Clinic was death due to renal tuberculosis.

Renal tuberculosis is primarily unilateral and is essentially a surgical disease. Israel asserts that there is no non-operative cure, and Wildbolz that it is a disease which only rarely is healed spontaneously. It is questionable whether healing ever takes place without operation. On the other hand, in rare cases relatively good health may be enjoyed for many years, even if the renal tuberculosis is extensive. Wildbolz reported cases in which patients with renal tuberculosis lived without marked discomfort for from ten to thirty years. The infection may be well localized, of low virulence, or the individual may, by reason of chronicity and numerous foci of infection, have acquired a tolerance and resistance to the bacillus. Braasch[3] believes that immunity develops with multiplicity of lesions. With removal of the renal focus, complete recovery may take place. In most cases the infection destroys the kidney, spreads locally, extends to the bladder and often causes disease of the other kidney. Kümmell found only five bilateral infections in 100 surgical cases of renal tuberculosis. On the other hand, in eighty-one of 119 necropsy cases the condition was bilateral. Wildbolz found that death occurred in ninety-nine of 316 non-operative cases during the first or second year after the onset of symptoms; only 20 per cent. of patients lived more than five years.

* Read before the Southern Surgical Association, December 11, 1923.

In 200 cases treated conservatively, reported by Kornfeld, only five patients lived more than six years.

Between 1894 and 1923, 874 cases of tuberculosis of the kidney have been treated surgically at the Mayo Clinic. The kidney was removed in 863 cases; exploration only was performed in nine. Five hundred and fifty-six (63.6 per cent.) of the patients were men, and 318 (36.4 per cent.) women. In eighteen cases the opposite side was also tuberculous. Complete post-operative data were obtainable in 611 (69.9 per cent.).

Age of Patients.—Renal tuberculosis is most common during early and middle adult life; 84.7 per cent. of the cases in this series occurred between the ages of twenty and fifty years; 21.7 per cent. of the patients died an average of four years after nephrectomy.

Definite localizing symptoms of renal tuberculosis in children are few and difficult to recognize. Until the last decade, such cases were rarely observed clinically, but necropsy records demonstrated that this disease was relatively frequent. The kidneys apparently have a predilection for tuberculosis in early life. Vignard found the kidney affected in thirty-three of 100 tuberculous children. He collected 138 cases of chronic renal tuberculosis in children, twenty-one of whom were less than ten years of age. Dickinson found renal tuberculosis in 16.2 per cent. of 300 children dying from tuberculosis. Vignard believes that the cavernous form is the most common; it increases the size of the organ, and resembles pulmonary tuberculosis. The kidney may be completely destroyed and reduced to a mere sac. A perinephritic infection is not uncommon and is a serious complication. Twelve of thirteen primary nephrectomies in young children in Vignard's collected cases were successful; one child died. Fifty-five (6.3 per cent.) of the patients in our series were less than twenty years of age. Thirteen (23 per cent.) are dead.

Renal tuberculosis rarely occurs in persons more than sixty years of age. Küster found ten of 335 patients more than sixty years; four were more than seventy. Wildbolz found forty-six of 561 patients more than sixty years old; eleven were more than seventy. Seventy-one of the patients in our series were more than fifty years; eighteen (25.3 per cent.) are dead.

Surgical Procedures.—Primary nephrectomy is the operation of choice. Conservative surgical procedures are not practical in cases of tuberculous kidneys, and at best, afford only temporary relief. Pousson collected sixty-three cases of nephrotomies for tuberculosis; thirty-nine (61.7 per cent.) of the patients died. Schmeiden reported seven cases of partial resection; in three the wound healed; in one it healed with a fistula; in two a second nephrectomy was necessary; one patient died. Partial resection for tuberculosis is generally a failure, even in cases of double kidney, owing to the fact that an apparently normal renal segment is usually well studded with tubercles. Minute areas of infection may be found readily on histologic examination. Surgical trauma may light up a quiescent area of infection and

require further operation later. In an earlier paper [4] a series of cases of double kidney were reported in which nephrectomy was performed for a tuberculous process apparently limited to one segment. On histologic examination it was found that the intervening tissue and the grossly normal segment were often definitely tuberculous.

Nephrectomy.—The usual procedure in the Mayo Clinic is simple extraperitoneal lumbar nephrectomy. The lumbar incision exposes only a limited, easily drained area, provides a satisfactory approach for even large caseating and hydronephrotic kidneys, and leaves the peritoneal cavity intact in most cases. The postero-lateral incision, starting at the costo-vertebral angle, extends downward and forward to a point midway between the crest of the ilium and the last rib. The latissimus dorsi, external oblique and internal oblique muscles are cut, care being taken not to injure the branches of the iliohypogastric and ilio-inguinal nerves. The transversalis fascia is opened between these two nerves. The erector spinæ muscles may either be partially cut or retracted toward the spine. The quadratus lumborum muscle and the costo-vertebral ligament are cut, if necessary, to complete the exposure. The peritoneum is retracted forward, and only rarely is in danger of being torn if the approach to the kidney is made at the posterior angle of the incision. The kidney is reached by tearing through the perirenal fat, which is generally adherent, œdematous, and not infrequently also infected, if the kidney is tuberculous. As much as possible of the perirenal fat should be removed, since if allowed to remain, it may cause persistent drainage. Tuberculous kidneys, unless they are hydronephrotic, occluded, or have been operated on, are, in most cases, not markedly adherent nor enlarged. The pedicle is clamped with two heavy forceps. If there is evidence of much fluid in the kidney, it may be necessary to avoid contamination by placing a third pair of forceps close to the kidney; the pedicle is cut between this forceps and the two hæmostatic clamps. The pedicle is firmly ligated and the inner clamp removed; the second ligature is tied while the second clamp is being removed.

Subcapsular Nephrectomy.—In certain cases of extensive perirenal adhesions or in which fixation has resulted from previous operative procedures, it is necessary to perform subcapsular nephrectomy. This operation was performed in thirty-five cases in our series. In most of these cases, protective adhesions to the fibrous capsule are firmly fixed to the kidney, making it more difficult to remove, but apparently the mortality is no higher than that following simple nephrectomy, but as a rule, the retained capsule and perirenal fat cause more persistent drainage. If this is a second operation, the incision is carried down through the fistulous opening, which usually exists. If it is impossible to free the surrounding adhesions, the incision is continued until the kidney is reached. The capsule is folded back and clamps are applied, as in simple nephrectomy. On account of the œdema and friability of the mass held by the clamps, it is sometimes advisable to leave the clamps in place for seventy-two hours without attempting to ligate the pedicle. In certain cases, if the capsule

is not thick and œdematous, it may be turned back and cut at the pedicle, the kidney may then be pulled through the opening, exposing the renal vessels, which may be ligated directly. (Fig. 1.)

Transperitoneal Nephrectomy.—The abdominal route is only rarely employed for the removal of tuberculous kidneys. Before our present methods of accurate urologic diagnosis existed, tuberculous kidneys were sometimes encountered and removed during the course of abdominal operations. The mortality was high following any type of nephrectomy in these early cases, and the added risk of peritoneal infection was not considered an important

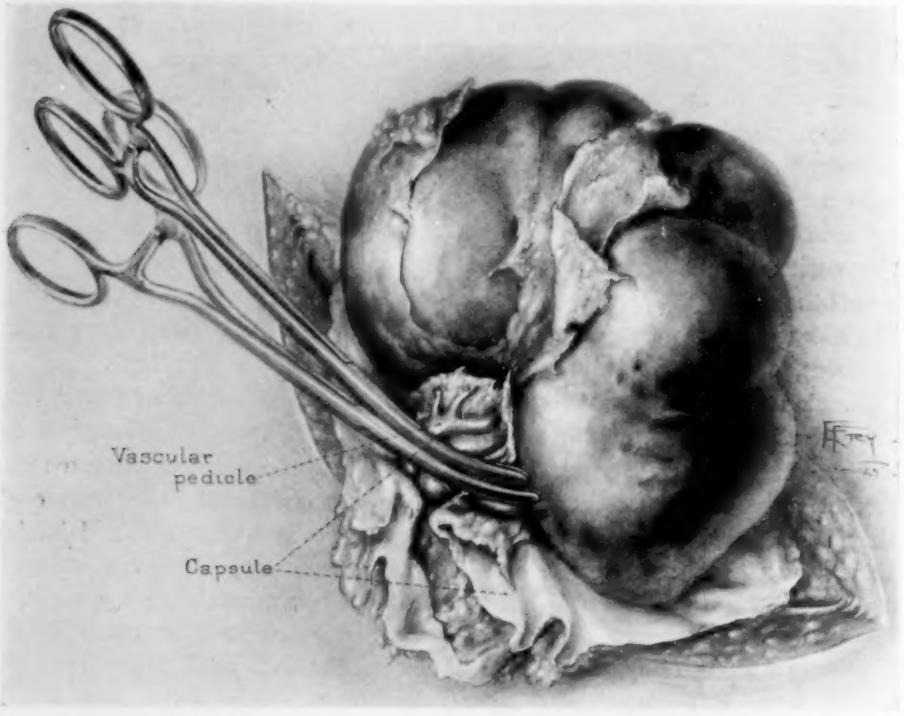

FIG. 1.—Subcapsular nephrectomy. The capsule has been cut, freeing vascular pedicle so that it may be drawn up for ligation.

mortality factor. Küster collected thirty-one cases of transperitoneal nephrectomy for tuberculosis; six (17.6 per cent.) patients died following operation. Seventy-nine (29.3 per cent.) of 269 patients who had had lumbar nephrectomy died. Since then, improved surgical technic and more satisfactory methods of approach have greatly reduced the dangers from lumbar nephrectomy, but the risk of peritoneal infection from transperitoneal operations persists. Not infrequently, small kidneys without secondary infection and with well-encapsulated tuberculous lesions are removed transperitoneally without causing contamination. Tuberculous kidneys may be present as abdominal tumors, or may be too large to remove by the lumbar route. In large acute hydronephrotic kidneys there is generally a severe type

of infection, and if extensive soiling occurs, secondary peritonitis may readily follow. Occasionally acute miliary tuberculosis may arise. Sometimes a tuberculous renal mass may rupture directly into the peritoneal cavity, causing localized peritonitis and necessitating a transperitoneal approach.

Disposal of the Ureter.—In most cases a portion of the ureter is removed. If it is strictured and dilated, it is desirable to remove as much as possible. Like the bladder, the ureter rarely remains infected after a tuberculous kidney has been removed. The extensive operation necessary to remove the entire ureter, exposing a wide area to infection and absorption, greatly increases the operative risk, and is rarely indicated. (Fig. 2.)

Various methods of disposing of the remaining stump of the ureter have been employed. Kocher injected iodin and Israel carbolic acid into the ureter. Kümmell employed an especially constructed thermocautery to obliterate the ureteral lumen. Zuckerkandl closes the wound completely, sutures the ureter to the lower angle of the wound, ligates, and cuts it at the end of the operation. After absorption of the catgut suture, the ureter withdraws into the depths of the wound. Walters, in a review of the Mayo Clinic

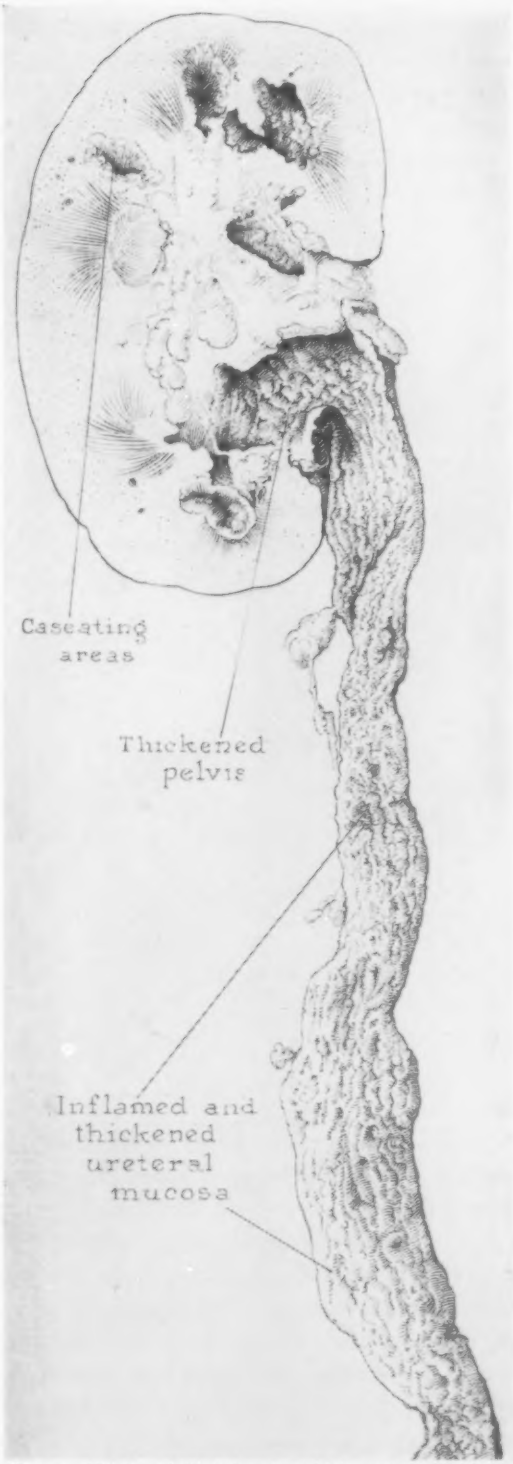

FIG. 2.—Thickened dilated ureter which contained a large amount of infected material.

cases, found that the ureter was usually cut with the cautery and the retained end ligated with catgut. In an earlier paper,[9] we described a method in which this ligated, infected portion of the ureter was isolated and brought to the surface of the wound through a section of rubber tubing, which also serves as an exit for wound discharges. W. J. Mayo cuts the ureter with the cautery, allows the bladder portion to drop back, and closes the wound without drainage. Wildbolz separates the ureter with the cautery and ligates the lower end. Israel, in a review of 1023 cases of nephrectomy for tuberculosis, says that the method of treating the ureter has no marked influence on the formation of fistula.

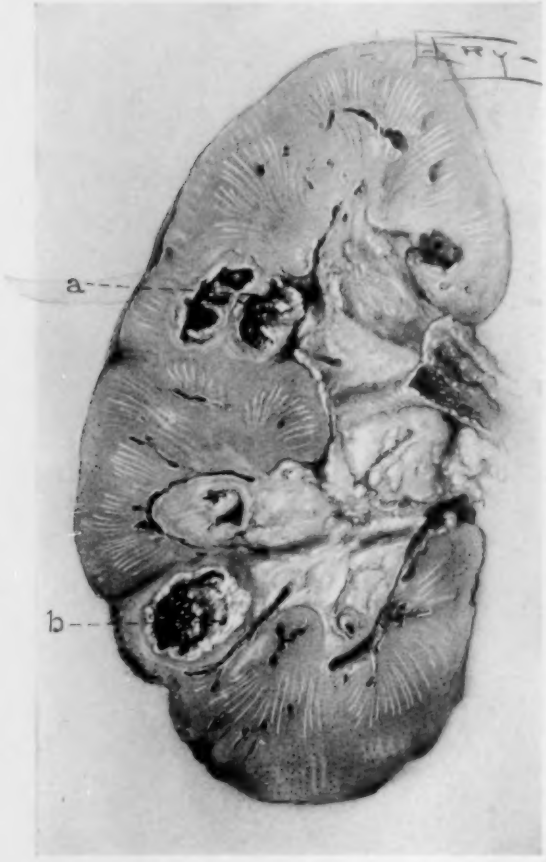

FIG. 3.—Small, early tuberculous lesion limited to several papillæ.

Pleura and Peritoneum.—In certain cases, perinephritic adhesions are so extensive that it is impossible to remove the kidney without opening one of the large cavities of the body. These openings should be sutured immediately. If there is no free perirenal infection and if the operation is completed without marked soiling, post-operative complications are rare. In certain other cases, both the pleural and peritoneal cavities may be opened during operation, without causing the post-operative convalescence to vary from that following an ordinary nephrectomy. In an occasional case, pre-operative surgical procedure may cause such extensive perinephritic adhesions that it is impossible to avoid opening the abdominal or pleural cavity.

Perinephritic Inflammation.—This is not an uncommon complication in cases of tuberculous kidney, and greatly increases the danger of primary lumbar nephrectomy. The risk is apparently greater when the peritoneal cavity is opened, although extensive soiling may occur without causing trouble.

In eight cases of our series perinephritic abscesses were drained, and secondary nephrectomy was performed. In most cases, the kidney with extensive perinephritic infection is of the completely destroyed, occluded type for which subcapsular nephrectomy is necessary. Good results are generally

obtained. One of the eight patients died two years after nephrectomy; the others are alive and well. After incision of a perinephritic abscess, the fistula generally persists until a second nephrectomy is performed. In an occasional case, the condition of the patient may prohibit an extensive primary operative procedure, necessitating a two-stage operation.

The high, early and late mortality in association with perinephritic abscess is in part, owing to the fact that tuberculous infection is generally of many years' duration, as evidenced by the extensive destruction of the kidney. The opposite kidney may reveal toxic nephritis, and the general resistance of the patient is much below that of patients with only a moderately extensive unilateral infection.

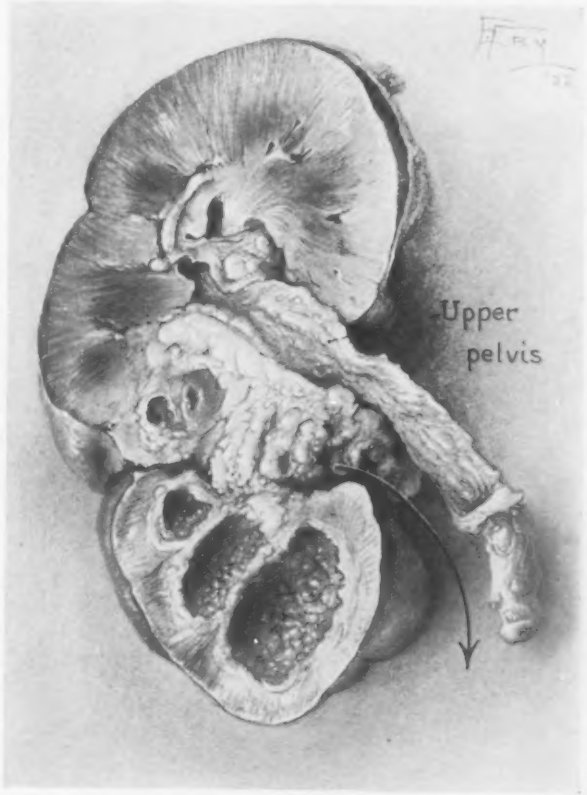

FIG. 4.—Caseation and infection confined to lower pole and simulating a double kidney.

In a second group of eight cases in the series, the perinephritic abscess was incised and nephrectomy performed at the same time. Two patients died several days after operation; one two years, and one six years afterward. The other four are living and well on an average of four years after the operation. Contamination of the peritoneal cavity is apparently more serious following nephrectomy than following simple drainage of the abscess. The greater area exposed to trauma and absorption reduces the general resistance of the patient to infection.

Bilateral Infection.—As a rule, renal tuberculosis is primarily unilateral. Delay in removing the infected kidney unquestionably increases the risk of infection in the opposite kidney. Israel found an extension to the opposite kidney in twenty-nine of 100 non-operated cases. On the other hand, in only thirteen (1.6 per cent.) of 1022 cases of nephrectomy for tuberculosis was there tuberculous infection in the remaining kidney. Kümmell found eighty-one bilateral infections in 119 necropsies for renal tuberculosis; in only five of 100 surgical cases was the infection bilateral.

The removal of one kidney in a case of bilateral infection is essentially a palliative procedure. Wildbolz asserts that there is no definite indication that it will cure even the smallest lesion in the opposite kidney. Rochet and Thévenot reported fourteen cases of nephrectomy for bilateral infection. In eleven, the infection in one kidney was slight; the kidney removed was extensively diseased. One patient died from uræmia two weeks after operation; four died later. Six lived, three of whom were in apparently good health. Three patients with severe infection of both kidneys, died promptly after the removal of one kidney. In certain cases of bilateral infection, removal of the more extensively diseased kidney apparently influences the remaining kidney favorably, and may unquestionably improve the patient's condition. Legueu collected ninety-three cases in which nephrectomy had been performed for bilateral infection. Thirteen patients died immediately after operation, most of them from anuria. Thirty died during the first three years after operation. Twenty-two were alive, seven one year, fourteen from two to five years, and one eight years after operation. In all, there was apparently bilateral infection, but the diagnosis of tuberculous disease in the remaining kidney may be questionable. On the other hand, there are undoubtedly many cases believed to be unilateral in which there is infection in the opposite kidney, even though there may be no signs of inflammatory reaction in the urine from that kidney. Braasch [5] has recently shown by guinea-pig inoculation, that in seven of twenty-two cases apparently unilateral, there was infection on the opposite side. Following removal of the obviously diseased kidney, these patients all have evidence of active urinary tuberculosis.

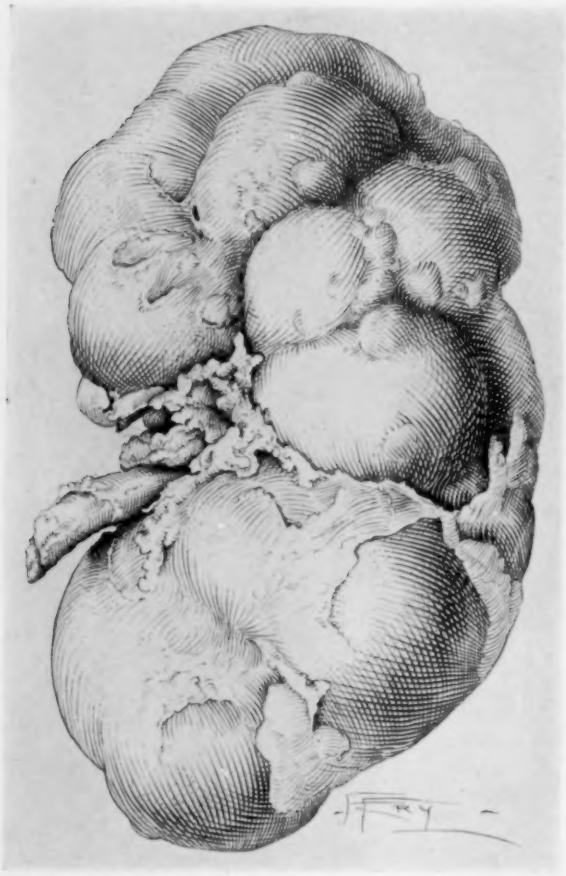

FIG. 5.—Soft fibrous sac of almost completely destroyed kidney. The ureter is stiff and thickened.

In our series there were eighteen cases of bilateral infection in which the

more extensively diseased kidney was removed. Four patients died of anuria immediately after the operation, and ten died during the next eighteen months, in most instances either from renal insufficiency or from other tuberculous foci.

Type of Lesion.—There are various types of renal tuberculosis that are important to the surgeon. The lesion may be small; it may be limited to the tips of several papillæ and the adjoining mucosa, or to several well isolated areas in the renal parenchyma (Figs. 3 and 4). On external examination and palpation, the kidneys sometimes appear normal. If the pelvis is involved, as is often the case, the ureter is enlarged, thickened and hardened. In an

FIG. 6.—Extensive tuberculosis of the kidney with caseation and destruction of the kidney.

occasional case, if the lesion is small, isolated, and well surrounded by fibrous tissue, the ureter may be normal and there may be no confirming data of tuberculous infection from an examination of the kidney. In such a case, the data from an accurate cystoscopic examination is more reliable than surgical palpation.

In the majority of cases treated surgically, the pelvis and ureter are extensively involved; there are numerous areas of caseation in the kidney, and sometimes areas of fibrosis and soft necrosis. (Figs. 5 and 6.) The surface of the kidney is studded with groups of small tubercles, and the perinephritic fat is œdematous and adherent to the kidney (Fig. 7.) In cases of long-standing, the kidneys may be almost completely destroyed and

smaller than normal, the pelves moderately dilated, and the renal parenchyma thin and sac-like. Enough urinary secretion persists to keep the bladder constantly infected. Occasionally in this type of case, one portion of the kidney may contain a large walled-off abscess which is readily ruptured on surgical manipulation.

With stricture and obstruction of the ureter, complete destruction of the kidney occurs. In such cases the obstruction has been gradual and of long duration. The mass is composed of a fibrous shell of the kidney containing caseating material. In some instances, calcareous deposits (Fig. 8) are sufficiently extensive to cast a complete röntgenographic shadow of the kidney. When there is complete occlusion of the ureter, the inflammation of the bladder subsides in most cases. Following obstruction, the retained infected urine and pus may rupture through the renal capsule into the surrounding tissues, or may break through into the peritoneal cavity. In most cases old occluded tuberculous kidneys are surrounded by only slight perirenal reaction; they may be removed readily and the wound closed without drainage. In thirty-four of thirty-nine cases of this type, the wound was closed without drainage and healed by first intention; in the remaining five, drainage continued for a short time. In many such cases there is no active tuberculous infection. Braasch,[2] in an endeavor to determine whether active tuberculosis bacilli were present, injected an emulsion from five such kidneys into guinea-pigs. In four cases, the guinea-pigs remained normal; the fifth died of diffuse tuberculosis.

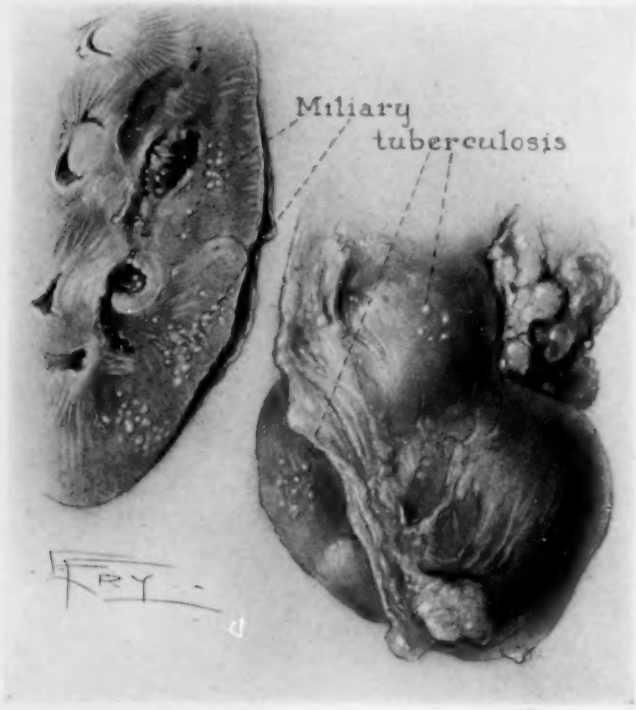

FIG. 7.—Miliary tuberculosis with only moderate involvement of the kidney.

In cases in which there is sudden complete obstruction of the ureter early in the course of the disease, acute, generally markedly infected, hydronephrosis may occur. Such sacs may become very large, containing from four to five litres of fluid in some instances. They may become adherent to the diaphragm

and peritoneum, and often are associated with extensive perinephritis. Like the completely destroyed kidneys, these hydronephrotic tumors may also rupture into the surrounding tissues, and it may be impossible to remove the kidney and capsule intact. In other cases, removal of the large dilated kid-

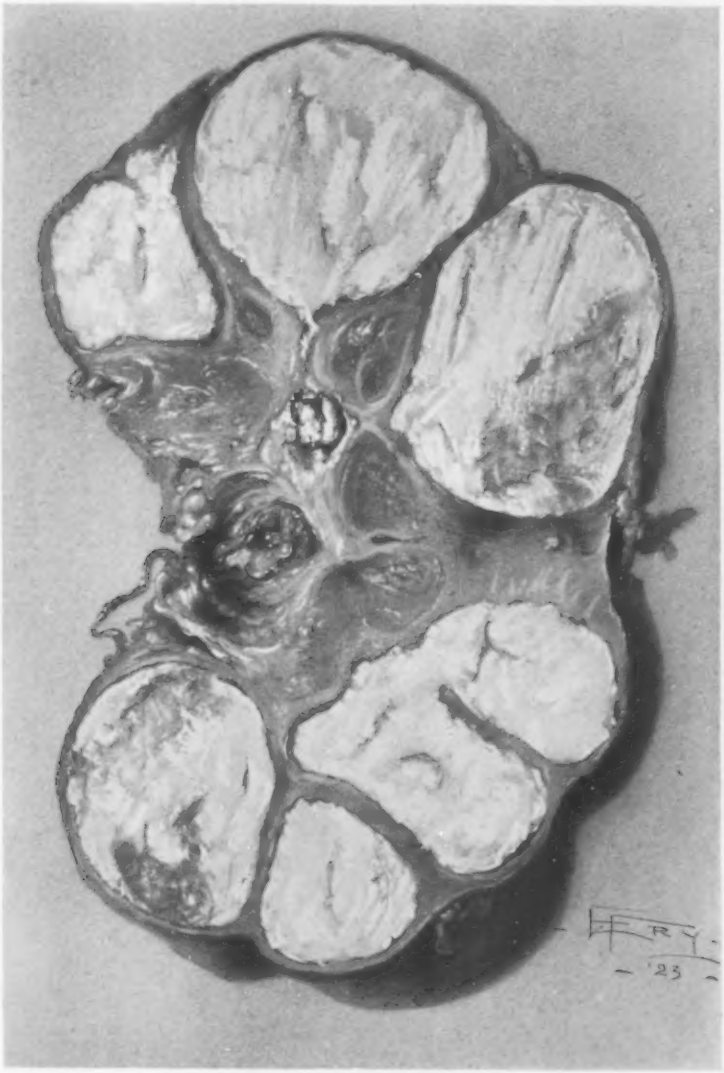

FIG. 8.—Fibrous shell of tuberculous kidney completely filled with caseating material undergoing calcareous degeneration.

ney, its capsule, and the adherent perirenal fat would expose a very extensive area for infection and absorption. In cases of this type, a subcapsular nephrectomy may be safer than complete removal of the kidney and perirenal tissues.

Post-operative Course.—The mortality following nephrectomy was high

in earlier cases. Schmieden reported a mortality of 25.4 per cent. in 106 cases between 1890 and 1900. Küster (1902) found a total mortality of 18.8 per cent. in 297 collected cases. In recent large series of cases the percentages are much lower; Boeckel reports 5.8 per cent. and Legueu and Chevassu 5.9 per cent. Israel, in a collected review of 1023 nephrectomies, found an operative mortality of 12.9 per cent., and a late mortality of from 10 to 15 per cent. Wildbolz asserts that the larger collected general reviews are not of as much value as the more carefully compiled statistics of individual surgeons. From the reports from several large urologic centres he collected 1450 cases with a mortality of 5 per cent. Only eleven (2.4 per cent.) of 445 of Wildbolz' own patients died following operations. Most of the deaths were due to heart or lung complications. Sixty-two per cent. of 317 patients, operated on at least one year before were cured; 30 per cent. were dead, and 8 per cent. still had evidence of disease. Fifty-five per cent. of 104 patients operated on at least ten years before were completely cured; forty-four died of tuberculosis mainly of the genito-urinary tract. In Kümmell's 188 cases, there was a mortality of 7 per cent.; of the remaining 176, sixteen patients died the first year, and fourteen in the next four years. Thirty-nine patients were well from fifteen to twenty years after operation, and thirty-eight from ten to fifteen years.

Three hundred and fifty-eight (58.6 per cent.) of the 611 patients in the Mayo Clinic on whom complete post-operative data were obtainable, are cured on an average of four years after operation; 191 (31.2 per cent.) are dead. Sixty-two (10.1 per cent.) still have evidence of tuberculosis of the genito-urinary tract. The patients still having trouble are mostly those who have been operated on recently. Persistence of discomfort of the bladder and tuberculous foci in other parts of the body, account for many of the persistent symptoms.

Operative Deaths.—Twenty-three of the 119 patients who died following nephrectomy for unilateral tuberculosis, died during the first month after operation. This number represented 2.7 per cent. of 845 nephrectomies. In the early cases, uræmia was one of the most common causes of death, and accounted for the large operative mortality. In many of the cases, it was the result of infection in the opposite kidney. With our present accuracy in pre-operative diagnosis, uræmia only rarely causes death. Only one of 175 patients on whom nephrectomy was performed, reported by Wildbolz, died of uræmia. Israel found that most of the early deaths in his reported cases were due to cardiac failure or to acute miliary tuberculosis.

Early Mortality.—Five patients in our series died after operation from uræmia. In most cases, death was due to a non-tuberculous infection of the opposite kidney, or to chronic nephritis. There were five deaths from peritonitis; in all instances the peritoneum was adherent to the kidney and opened during the course of the operation. In three cases, pulmonary complications; pneumonia, empyema, and pulmonary embolism, respectively, caused death. One patient died from general septicæmia, and one from paralytic ileus.

Wildbolz cited a case similar to this in which paralytic ileus occurred following nephrectomy; the peritoneal cavity was not opened. One patient died from post-operative hemorrhage on the fifth day. At necropsy, general miliary tuberculosis was found. In two cases the cause of death was not determined. In two cases operations had been performed elsewhere in an attempt to remove the kidney; in a third a perinephritic abscess had been drained. In one, death occurred the second day from tuberculosis of the adrenal, and in one case a tuberculous kidney had ruptured into the chest before operation. In one, death was due to thrombosis of the vena cava.

Late Mortality.—Israel believes that the chief causes of late post-operative death are pulmonary tuberculosis and tuberculous infection of the opposite kidney. He found, in a series of cases, that more than one-half of all late deaths occurred within two years after nephrectomy. Pulmonary tuberculosis was the cause of death in 45 per cent., tuberculosis of the kidney in 35.9 per cent., and acute miliary tuberculosis in 14 per cent. He also believes that 73 per cent. of all pulmonary tuberculosis causing death existed before operation. Of the late deaths, due to renal insufficiency, 69.5 per cent. were caused by renal tuberculosis; in 30.5 per cent. there was no tuberculosis. He reports several cases in which the patient survived the operation more than nine years, then died of a tuberculous infection in the opposite kidney.

Forty-two (25.6 per cent.) of 164 subsequent deaths occurred in the first year, eighty-three (50.6 per cent.) from the second to the fifth year, and twenty-one (12.8 per cent.) from the sixth to the tenth year. In eighteen the date of death was not known. Thirty-one died from infection of the remaining kidney, which was tuberculous in fifteen.

Meningitis is often the cause of late deaths. Simmonds found at necropsy that 30 per cent. of men with genito-urinary tuberculosis had died from meningitis, and only 5 per cent. from pulmonary tuberculosis, none from infection of the genito-urinary tract.

There were five late deaths due to meningitis. In the cases in which extensive local infection of the wound, general miliary tuberculosis, or extension to the meninges develop, the kidneys are not infrequently of the acute, septic, hydronephrotic type.

Twenty-one patients died of general miliary tuberculosis, and twelve of pulmonary tuberculosis. Three died of tuberculosus peritonitis. The remainder died from causes other than tuberculosis.

SUMMARY

Eight hundred seventy-four patients with renal tuberculosis were treated surgically. Nephrectomy was performed on 863 and an exploratory operation only, on nine. Complete post-operative data were obtainable concerning 611 patients. Usually complete lumbar nephrectomy was performed. In a few instances, transperitoneal nephrectomy was performed or the peritoneal cavity was opened while the kidney was being removed by the lumbar route; such contamination of the peritoneal cavity markedly increases the operative risk.

In the presence of a perinephritic abscess, removal of the kidney and drainage of the abscess at the same time increases the operative risk. Two of eight patients died following such procedures. None of the eight patients died on whom the two-stage operation was performed.

In eighteen cases of bilateral infection one kidney was removed. Four patients died from anuria immediately after the operation, and ten died during the next eighteen months.

Twenty-three patients (2.7 per cent. of 845 who had had unilateral nephrectomy) died the first month after operation. One hundred ninety-one (31.2 per cent. of the 611 patients) are dead; 358 (58.6 per cent.) are completely cured on an average of four years after operation, and sixty-two (10.1 per cent.) are still having urinary trouble.

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PILONIDAL SINUS *

(COCCYGEAL FISTULA)

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The lesion known in American literature as pilonidal sinus, and on the Continent, chiefly by the name of coccygeal fistula, may not fairly be considered of major surgical importance, nor is it of sufficient rarity to cause interest as a surgical curiosity. It does, however, deserve attention because of the frequent mistakes made in its diagnosis, the confusion with fistula in ano, and the various explanations of its etiology. Moreover, very little reference to the subject is to be found in the literature. Less than a dozen original articles have been found in a fairly extensive search covering the past sixty years, and the standard texts on general surgery carry little or no reference to the subject. Even the special volumes on rectal surgery are notably lacking in discussion of it. It has therefore seemed worth while to present the salient facts in regard to pilonidal sinus, with a collection of a number of cases.

The lesion presents itself, in its uncomplicated form, as a small orifice—3 to 5 mm. in diameter—in or near the posterior midline of the body, at about the level of the sacro-coccygeal joint. The orifice is round or oval and its edges are smooth, skin covered, and free from granulations. Occasionally a small tuft of hair projects from the opening. A probe passed into the orifice finds a sinus tract usually passing upwards toward the sacrum for a variable distance, in most cases only 1 to 2 cm., but occasionally 5 to 6 cm. This tract, when studied histologically, is found lined with epithelium. Often there is a mat of loose hair lying in the sinus. The sinus ends blindly, perhaps in a sacculated pouch, and does not communicate with any other structure. In those cases that have become infected the picture is modified by inflammatory signs, swelling, tenderness, etc., along the course of the sinus, perhaps the discharge of pus through the orifice, and particularly by the development of adventitious orifices in the neighborhood, usually to one or other side of the midline, also discharging pus. These differ from the original orifice in being ordinary fistulous openings, lined by granulations, and with an ulcerated ragged orifice.

The first record of this lesion that I have been able to discover is that of J. M. Warren,[1] 1867, who clearly presents two cases, and remarks that he has nowhere seen a description of such a lesion, although he thinks he has encountered personally eight or ten instances. Only one was in a woman, of dark and hairy type. The others were in hairy men. He notes the tendency to confusion with fistula in ano, and states that the sinus should be dissected out. Warren advances the rather imaginative theory that the cause of the trouble is a reversed hair-follicle, and that the turned-in hair, as it continues to grow, "pulls its hole in after it," as it were.

* Read before the Southern Surgical Association, December 11, 1923.

In 1880, Hodges[2] refers to Warren's description, which he states is the only reference he can find in the literature, and he describes the lesion, but makes the error of stating that the sinus has no lining membrane except ordinary granulation tissue. He could find only one case in the female in the records of the Massachusetts General Hospital, the case of Warren's. Hodges gave the name of pilonidal sinus to the lesion—a nest of hair—and believed the hair was the cause of its development. He thought short, loose hairs from the surface, in people of unclean habits, accumulated in a post-anal dimple, excoriated the skin, and worked their way into the deeper tissues, causing a sinus. In the same volume Hodges and Post report other cases.

Mason,[3] also in 1880, reports a case in a woman.

In 1883, Couraud[4] in a French thesis, discusses at length the questions of post-anal dimple, pilonidal sinus and post-sacral dermoid. He gives credit to Warren as first describing the lesion here discussed and covers the other bibliography of the related subjects. He thinks the dimples, sinuses, and dermoids are various degrees of the same process, and quotes various views as to its etiology. Two of these have already been mentioned. Kuhn (quoted) considers these lesions remaining traces of hydrorachis or spina bifida. Lawson Tait (quoted) regards the dimples as defects due to the evolutionary disappearance of a caudal appendage. Féré (quoted) thinks a failure of the two halves of the body to unite properly behind is the explanation. The writer then reports three cases of his own and Schwartz and quotes several others from the literature.

In 1885, Wendelstadt,[5] in a Bonn thesis, reports three cases, and again reviews the literature, which is not appreciably fuller than in Couraud's thesis. He thinks the loose hair plugging the orifice of the fistula is often the cause of retention and infection. Points out confusion of this lesion with fistula in ano and osteomyelitis of sacrum or coccyx. He advises surgical removal of the sinus tract, and advises against treatment with chemical injections. He advances the following idea of the etiology. The inferior end of the spinal cord is the last portion to lose its connection with the skin. As the sacrum closes together and pinches off this connection, the skin becomes attached by fibrous tissue at this point to the posterior surface of the sacrum. As adult life approaches, fat and soft parts grow and lift the skin farther away from the bone. The attached spot is thus drawn down into a dimple or sinus.

Hermann and Toureux,[6] 1887, after discussion of the theories above mentioned, direct attention to the embryology of the posterior end of the neural axis. They show that after the separation of the spinal cord from the superficial tissues a process of epithelial tubules persists for a time at the point of previous connection of the neural axis with the skin, forming a vestigial remnant of that connection. To this remnant, which normally completely disappears, they attribute the formation of pilonidal sinus, when atrophy fails to take place.

E. J. Beall,[7] in 1889, reported five cases of what he calls coccygeal dermoid, all in male patients, and points out that they are commonly not correctly diagnosed, but are mistaken for ordinary abscesses, caries of the coccyx or sacrum, or for fistula in ano. He believes them to be more frequent than the literature indicates, and advises thorough surgical removal of all the abnormal tissue.

Graham,[8] 1897, credits Hodges with first correctly describing and naming this lesion. He also states that he could find only two references to the lesion in surgical works, once as a lesion of the spine, and once as a disease of the rectum. Distinguishes between the small, deep pit of pilonidal sinus and the broad, shallow depression known as post-anal dimple. He reports one case.

It will be seen that the references herewith quoted, which cover all the direct consideration of this subject in original articles that were found, are few in number, present in all a very few cases, and are vague on such matters as the histology of the lesion and its etiology. They are all clear and definite

on the clinical picture presented, and on the proper treatment—complete surgical removal.

The writer has collected the cases on record at the Johns Hopkins Hospital, for which permission he is deeply indebted to Doctor Finney, and has added his own private cases thereto. These have been studied particularly with the following points in mind: Age, sex, and race of patients, previous operations, and histological study. In the Johns Hopkins Hospital records forty cases were found. In addition, the writer has seen twenty-one cases, making a total of sixty-one cases in all. Every one of these patients was white; in spite of the fact that Baltimore has a large negro population, and the hospital has always had an active colored service, no case in the negro has been seen. Only ten of the sixty-one cases were females, 16 per cent. Two patients were forty-nine years old when operated on, the most advanced age in the series; three were eighteen, the youngest recorded. The average reduced age—that is, the age of admission less the number of years the lesion had been observed—for the whole series is twenty and one-half years. Clearly the condition although congenital, first gives trouble in early adult life. Twenty-five, or nearly half of this series, had been operated upon, in some manner, at least once previously, and one history bears the note "eight or ten previous operations"—a point to be referred to later. One case also presented a bifid uvula and hypospadias. Among my own cases is an interesting group; a father and two sons all of whom were operated upon at different periods for pilonidal sinus. These cases and the age of incidence throw light upon the congenital character of the lesion. Many of these patients had suffered recurring trouble with the sinus for a long period of time, in several instances for more than ten years, and in two for over twenty years.

The writer was fortunate enough to discover and remove cleanly, a typical sinus which had never been actively inflamed. This he believes to be good practice, but incidentally it afforded material for histological study much better than is usually obtained from acutely infected sinuses. The specimen was dissected out whole at operation, and blocked and sectioned thus, without opening it. The lumen of the sinus contained hairs. The inner portion of the wall was of many layers of stratified cuboidal epithelium with only slight cornification adjacent to the lumen, but with imperfect and rudimentary papillæ in certain areas. Hair follicles were seen and also sweat glands. Outside of the epithelial layer was a dense corium-like sheath, and beyond this loose fat and areolar tissue. Some of the sweat glands lie in the fat at quite a distance from the lumen of the sinus. In short the sinus is a slightly modified invagination of true skin. None of its elements were fully developed —even the characteristic hair is thin, fine and scanty in pigment, somewhat like lanugo.

In reviewing the literature above, the various theories of origin of these little sinuses were outlined. None of them seemed quite clear. In an effort

to understand better the character of this lesion, evidently congenital and of embryonic development, recourse was had to Dr. George L. Streeter of the Department of Embryology, Carnegie Institute of Washington, Baltimore, Maryland. Doctor Streeter was good enough to place the rich material of his department at my disposal, and aid me with his even more valuable advice. In spite of these advantages, no satisfactory explanation of the problem has yet been found. It is true that for a time a small cystic remnant of the lowermost portion of the medullary groove persists and is known as the "coccygeal medullary vestige." This is lined by a single layer of columnar cells and is doubtless the structure to which Hermann and Toureux have referred. Normally, this little cystic structure has no opening communicating with the skin, and ultimately disappears. Furthermore, its cells are similar in appearance to those lining the central canal of the spinal cord, and in Doctor Streeter's opinion have already become so differentiated that they could not be expected later to give rise to skin, even though the cystic remnant should persist. It is Doctor Streeter's view that pilonidal sinus must be regarded as a special local down growth of epithelium, originating from the true skin and not from the medullary groove. The skin in certain regions forms organs like the breast, and the external ear, by just such an invagination. No suggestion is as yet advanced as to why such an invagination takes place occasionally in the coccygeal region. In short, beyond the feeling that the skin and not the neural groove is the source of the sinus no facts are present to explain the origin of the lesion.

Personal experience with these cases, a review of hospital records, and a survey of the literature have all led to certain clear-cut ideas as to the clinical aspects of this interesting lesion.

First, as to diagnosis. To one who has ever knowingly seen a pilonidal sinus, there can be no difficulty. To those who have not chanced to see a case the following points should immediately suggest the diagnosis: Its situation, over the coccygeal region, well posterior to the anus; the midline or nearly midline orifice, with its smoothly rounded edge, and with or without a tiny protrusion of hair from its lumen. If there is no active inflammation, a cord-like structure can often be felt running upward and backward a short distance from the orifice. As a rule there is inflammation, as that is the reason for seeking medical aid. Here one must be on guard against mistaking the lesion for fistula-in-ano or disease of the underlying bones. The long history so often obtained may misleadingly suggest these possibilities. A probe passed into the sinus should throw much light on the question. Instead of going toward the anal canal, as in fistula, it passes upward and backward away from it. The bare bone of osteomyelitis also is, of course, not to be felt. Confusion may be caused by incidental inflammatory orifices of secondary origin, but the original orifice is characteristic and should be sought for.

The diagnosis once established, the problem of treatment is easily solved. It consists in the complete excision of the whole tract with its entire wall.

The area excised should be wide enough to include the sweat glands in the tissue removed. Anything less is unsatisfactory. Yet our experience and that of others shows that all too commonly incision and drainage or palliatives, such as poulticing, may be employed. No case can be considered permanently cured until the sinus wall is removed. As long as any of it remains, recurrence of inflammation may be looked for. Cases seen before infection has occurred should be excised, as such wounds may be closed cleanly, the operation is short and easy, and the probability of later infection through the open orifice, is thus avoided. This is not meddlesome surgery, but sound prophylactic surgery. When first seen *after* infection has occurred, drainage following excision is usually necessary and sometimes this wound takes a surprising time to heal. The location of the lesion is such that healing by granulation progresses slowly. Non-surgical treatment is usually a waste of time.

SUMMARY

Pilonidal sinus is a congenital defect. It occurs principally in males, and has not been described except in the white race. It is not rare. It may be familial in incidence and associated with other anomalies of development.

The diagnosis is made from its position and the appearance of its orifice.

The treatment is complete surgical excision.

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COMPLETE OUTWARD DISLOCATION OF THE PATELLA*

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Exposed as the patella is to all sorts of trauma, it is singularly free from dislocation. Dennis [1] says: Dislocation of the patella occasionally occurs and forms about 1 per cent. of all dislocations. Stimson [2] writes: Dislocations of the patella are rare, less than 1 per cent. of all dislocations; and the infrequency with which they have come under the observation of individual surgeons and the incompleteness or the obscurity of the reports of many cases have combined to make the systematic descriptions rather artificial and unsatisfactory. Eisendrath [3] announces: About 200 cases of dislocation of the patella have been reported. Astley Ashhurst [4] states: It is also seen very occasionally as a traumatic lesion. As recently as 1922, when discussing this question, Dennis Crile [5] said: Dislocations of the patella are rare and the patient is not usually seen while the dislocation persists. Spontaneous reduction or reduction by the patient or a friend is usually accomplished before the surgeon arrives. In view of its acknowledged rarity, I believe, that the following case of complete outward displacement of the patella is of sufficient interest to justify its presentation:

Report of Case.—Miss L., white, female, school-teacher, aged nineteen, on September 8, 1923, sustained an injury to her left knee by stumbling over a suit-case. She endeavored to regain her balance, but failed, and fell to the floor, where I found her a half hour later. She was in great pain and resented any attempt to change her position, as the slightest movement of the injured limb increased her suffering. The knee was not swollen, but was slightly flexed, broader than normal, and visibly misshapen. Beyond the inferior articular surface of the femur and resting against the outside of the external condyle was a bony mass which touch and sight identified as the patella. Its anterior surface was palpable throughout and looked outward. The inner margin of the knee-cap was directed forward, its outer border was turned backward, and its articular surface was in contact with the external condyle. The patella was fixed. The leg was flexed on the thigh. The knee-joint was stiff and immobile. The site of the intercondyloid notch was indicated by a crease in the overlying skin. Both condyles could be felt. The tendon of the quadriceps extensor muscle and the ligamentum patellæ were tautly contracted and stood out like whipcords. The clinical evidence was so frank as to leave no doubt as to the nature of the injury, *viz.*, a complete outward dislocation of the patella, which was in the absence of any visible evidence of trauma attributed to muscular violence. An X-ray examination was not obtained because of (1) the obviousness of the diagnosis; (2) the urgent insistence of the patient for relief from her suffering. The replacement of the bone was therefore undertaken without anæsthesia, and much to my relief easily accomplished. The thigh was flexed on the pelvis, the leg extended and pressure exerted on the outer border of the patella. Almost immediately the bone flew back into place with an audible snap. Instantly the young lady expressed herself as free from pain. As a safeguard against the recurrence

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of the dislocation a plaster-of-Paris case was applied from the ankle to the groin. This was removed two weeks afterwards and the girl allowed to get about on crutches. She has now regained the full use of her leg and reports herself as completely cured.

Dislocation of the patella is almost always outward. The injury may follow a blow upon the inner margin of the patella, but fully as often results from a sudden, violent muscular contraction, especially if the knee is flexed and turned inwards as in catching one's self while falling. According as the patella is still in contact with the trochlea or lies upon the epicondyle, the luxation is classed as incomplete or complete. Both forms occur with about equal frequency. When the dislocation is complete the patella may assume any one of three positions. Its articular surface may face the condyle with its external border behind and its inner in front; or the inner margin of the patella may impinge against the external condyle with its anterior surface looking directly forward, the knee-cap having undergone no rotation; or the inner margin of the patella may dip backward with its anterior surface in contact with the external condyle and with its outer border pointing forward. In the incomplete type of outward dislocation, the patella does not entirely leave its articulation with the femur, but is merely carried more or less to the outer side. Generally its inner border is caught in the intercondyloid notch and the outer half of the patella overhangs the external condyle where it presents as a prominent swelling on the outer side of the knee with its anterior surface looking obliquely inward and backward as the result of a partial rotation. The strong leaning of the patella toward the outward variety of displacement is not a matter of chance. The conformation of the knee-joint and the muscles attached to the patella enter largely into the choice. The external condylar ridge is considerably less prominent than that of the internal condyle and the pull of the quadriceps is upward and in a direction parallel to the long axis of the femur. Since the femur and the tibia join each other at an obtuse angle with the apex directed inwards and the ligamentum patellæ lies in the long axis of the tibia, the quadriceps when it contracts not only pulls the patella upward but also exerts considerable outward traction on this bone. To counterbalance this tendency, nature has supplied man with a strong internal lateral ligament and has scooped out the lower end of the femur in such wise as to tightly engage the irregularly wedge-shaped posterior surface of the patella when the knee is extended and the thigh muscles contracted. Notwithstanding the excellent protection thus afforded against dislocation by this arrangement, a violent contraction of the quadriceps or a blow upon its inner margin may suffice to dislocate the patella, especially if the ligaments are relaxed and the lip of the external condyle is underdeveloped.

The symptoms are characteristic. The slightly bent leg is held stiff and immobile, for fear of exciting pain. The knee-joint is broader than normal and there is a visible as well as a palpable prominence on its outer side. The condyles can be felt and the trochlea is indicated by a groove in the overlying skin. The extensor tendon and the ligamentum patellæ are tautly contracted.

An X-ray examination will verify the diagnosis. After reduction there is no great tendency to recurrence of the luxation. According to v. Bergmann,[6] even if the dislocation persists, the use of the limb is gradually recovered and hard work is possible, but extension is limited and the genu-valgum becomes more pronounced.

In recent cases a closed reduction with or without anæsthesia is generally feasible. When such efforts fail an open replacement must be made. This can be done either by a straight or a curved incision. Habitual luxation has been cured by non-operative treatment, but usually requires an operation. Bajardi has accomplished a cure by cutting out of the inner side of the capsule an oval slice of redundant tissue and suturing the margin of the defect, thus created, together. Le Dentu has obtained satisfactory results by reefing the relaxed capsule. Albee[7] splits up the front of the condyle and elevates the fragment until a wedge-shaped hiatus is formed into which he inserts a chunk of bone cut from the tibia, holding the graft in place with a pin. In some instances it has been found necessary to chisel off the tubercle of the tibia and transplant it inwards. Whilst the methods enumerated above, either alone or in combination generally suffice to effect a cure, on occasion some more complicated technic needs be exploited. Whenever a rent is found in the capsular ligament, be it in a fresh dislocation or in a recurrent displacement, the hole must be sewn, regardless of what else is done.

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PRIMARY PERITONITIS *

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The early literature of peritonitis is of interest more from an historical standpoint than a scientific one, inasmuch as it was only with the recognition of the true nature of pus that it became a pathologic entity. From this, to modern times, peritonitis existed in two forms, known and unknown, and the latter, if anything, more numerous than the former.

In 1880 Grawitz [1] essayed to refine this classification and divided the disease into primary and secondary groups, including in the first what he termed rheumatic or idiopathic forms, and in the second, those of known origin in the abdominal viscera.

Upon this ground work Tavel and Lanz,[2] in 1893, published their classification which substituted "chemical" for "idiopathic" and multiplied the phases of the secondary forms.

All this, while it dignified and amplified the previous conception, did not materially alter it.

Consequently, with a more rational method in view, Flexner [3] published in 1898 his work on the etiology and classification of peritonitis. In this he recognized two great divisions, primary and secondary, stating that, "By primary peritonitis is understood a condition in which an inflammation of the serous cavity arises without the mediation of any of its contained organs and independent of any surgery upon these parts."

The term primary peritonitis is in a way a misnomer, for in our contact with neoplastic diseases we have come to consider a primary lesion as the initial site of the disease process. In fact, to the clinician, "primary" possesses an absolute value rather than a purely relative one. Thus, an otitis media may be the primary body lesion and eventuate as a blood-borne peritonitis which in turn, as regards peritoneum and viscera, is an essentially primary disease.

With this understanding of "primary" we can group under this heading the "essential" peritonitis of Duparque, the "rheumatic" of Grawitz, the "chemical" of Tavel and Lanz, the "pneumococcic" of Bozzolo [4] and the idiopathic of the host of other writers on the subject.

Previous to 1860, although many cases were reported as idiopathic, or (as we would consider them) primary, the data is unconvincing and inadequate. Perhaps the first really plausible case record was that made by Behier and Hardy [5] in 1864, while Duparque in 1867, presented a more complete report which is identified as a "pneumococcic" peritonitis.

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Hertzler [6] credits Bigelow [7] as reporting the first satisfactory case in American literature in 1872.

From this time to the present date the literature of the subject has consisted mainly in reports of scattered cases. Of the more pretentious articles are those of Michaut,[8] Annand and Bowen [9] and Von Brunn [10] on pneumococcus peritonitis, the earlier reports of Flexner and Manahan,[11] together with the more recent ones of Fishbein,[12] Rabinowitz [13] and Melchoir,[14] on primary peritonitis other than the pneumococcic.

Despite the large amount of reported material the disease possessed a questionable status up to very recently. In a measure this may have been due to the recognition of appendicitis and the subsequent vogue of appendectomy. From the belief that some peritonitides were at least inexplicable, the profession generally assumed that any peritonitis of undemonstrable origin was due to appendicitis and looked with disfavor and suspicion upon any surgeon who failed to substantiate this opinion.

Moreover, Nothnagel,[15] in 1901, emphatically denied the possibility of a primary peritonitis, and Armstrong [16] insisted in the face of some biologic difficulties that all primary peritonitis was essentially an infection of the Fallopian tubes. The observations of Jensen [17] working on animals and those of Dieulafoy,[18] Weichselbaum,[19] Lennander and Nystrom [20] appeared to strengthen Nothnagel's contention.

However, Kunzel,[21] in 1904, presented a definite case of peritonitis in which he had made most elaborate and detailed gross, microscopic and bacteriologic examinations and in which he was able to establish its identity as a blood-borne infection from the naso-pharynx.

The later reports of Chapelle,[22] who exhaustively studied the sore throat epidemic in Helsingfors and the observations of Fishbein, Rabinowitz, Ruppanner [23] and others serve to strengthen this position to a degree that primary peritonitis in the sense of Flexner's classification must be accepted as a definite hæmatogenous disease process.

From the autopsy records of the Pathological Department at the University of Minnesota, through the courtesy of Dr. E. T. Bell, I have been able to collect twenty-eight such cases. In the majority of instances I have been able to supplement them with their respective hospital charts which makes available a moderate amount of clinical data. As it would be a footless undertaking and only lead to confusion to enumerate these severally, I have attempted to summarize the findings under a relatively few important headings.

These I have arranged in tabular form, as follows:

The difficulty in establishing a distinct syndrome which might be of diagnostic value is at once made manifest by the shortness of the series, although from even this inconsiderable number some conclusions may be drawn. Apparently there is no sex prediliction and the age incidence is so variable as to be of little import.

Of the ten cases in which there was no known origin or accompanying disease elsewhere in the body, five had pain and vomiting at the onset while the remainder had neither pain nor vomiting.

In the eighteen cases accompanied or preceded by other sites of infection only four noted pain as an abdominal symptom and only five vomited.

In the tabulation of results, the temperature record is of necessity inadequate as it is not possible to present the daily range and progress and only the consistently high readings have been recorded. Examination of the available hospital records in all instances shows an early rise with a rapid development of the septic curve. The few instances of low temperature occurred in adults with no accompanying disease and who reached a fatal termination in very few days.

Leucocytosis is an almost invariable finding, the one exception being a leucopenia in influenza. The total counts observed show an average mean around 20,000, although in two instances they amount to 40,000. The differential count exhibits little of significance, the P. M. N. forms usually being increased to eighty per cent. or more.

In contrast to the majority of observers, but in accord with Rabinowitz, diarrhœa was found to be an infrequent occurrence, being noted in only three instances.

The foregoing summarizes briefly the phase of onset. As the condition develops two features become almost constantly in evidence, *viz.*, distention and fluid.

In twenty of the twenty-eight cases the records give marked abdominal distention as the chief terminal symptom and the autopsy findings note the presence of fluid in relatively large amounts. Whether this is always in a clinically demonstrable amount, particularly in infants, it is difficult to say, but from the appended clinical notes it appears readily recognized in children and adults.

The prognosis in this type of peritonitis is always gloomy, but perhaps not so entirely hopeless as a casual observation of the statistics suggests. It is undeniable that in the twenty-two unoperated cases the mortality was one hundred per cent., which allows little to be hoped for from expectant treatment, but of the six which were treated surgically, two survived operation. This of course is in itself inconclusive, but at least it emphasizes the possibility of a lower mortality at the hands of the surgeon.

The autopsy findings as a whole agree with the reports published elsewhere, except as to the type of invading organism. In the face of the many reported cases of pneumococcus peritonitis the occurrence of but one case in the series is surprising, although the absence of bacteriologic studies in nine instances may be sufficient explanation.

As to the nature of the peritoneal content, little can be said to amplify what has been expressed in the table. In most instances it was frankly purulent in character and profuse in amount.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	TOTAL
MALE	+	+	+	+	+	+		+			+	+						+			+								11
FEMALE							+		+	+	+			+	+	+	+		+	+		+	+	+	+	+	+	+	17
AGE	25	44	2m	3m	3m	46	30	11w	8w	13	6w	6w	9	28	62	9	50	50	8m	5m	16m	50	6w	66	28	7w	58	10w	
DISEASE	INFLUENZA	0	ERYSIPELAS	PNEUMONIA	PNEUMONIA	ERYSIPELAS	0	0	0	SORE THROAT	ERYSIPELAS	0	0	SORE THROAT	0	0	INFLUENZA	0	OTITIS MEDIA	SORE THROAT	SORE THROAT	0	OTITIS MEDIA	0	0	ERYSIPELAS	PNEUMONIA	STEPHACE	
OPERATION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
LIVE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
DIE	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	26
DURATION	1	5	?	?	6	5	?	3	?	7	2	7	8	10	4	5	1	3	7	2	8	4	1	7	7	?	1	17	
PAIN	+	0	0	?	0	+	0	+	?	0	?	0	0	0	+	+	+	+	0	?	+	+	?	0	0	0	+	0	10
RIGIDITY	0	+	+	?	0	0	0	0	?	0	?	0	0	0	+	0	?	0	?	?	+	+	?	0	0	0	0	0	5
DISTENTION	0	+	0	?	+	+	+	+	?	+	?	+	+	0	+	0	+	+	+	+	+	+	?	0	0	0	0	+	20
EMESIS	0	0	0	?	+	+	0	+	?	+	?	0	0	0	+	+	+	+	0	+	+	0	?	0	0	0	0	0	10
DIARRHOEA	+	0	0	?	0	0	0	0	?	0	+	0	0	0	0	0	0	0	0	0	0	0	?	0	0	0	+	0	3
TEMPERATURE	105	99	104	?	105	100	100	100	103	104	105	103	102	103	100	?	?	105	?	105	104	104	?	102	104	103	104	103	
LEUCOCYTES	41,000	9000	?	?	22,000	22,000	?	?	24,000	?	18,000	12,000	14,000	12,000	2,000	24,000	?	22,000	?	8000	35,000	?	?	?	18,000	?	3000	?	
FLUID	200	400	250	100	75	100	75	250	30	400	50	150	1,000	500	300	150	900	30	100	100	500	100	100	200	25	200	50	40	
CLEAR														+															1
PURULENT	+	+	+	+	+					+		+	+		+	+				+	+	+	+	+	+		+	+	17
TURBID						+	+	+	+		+						+	+	+				+			+			10
ORGANISM	STREP	?	STREP	PNEUM	STREP	?	?	STREP	STREP	STREP	STREP	STREP	STREP	0	STREP	STREP	?	BACIL	?	?	STREP	?	STREP	?	?	STREP	B. COLI	STREP	

One case, however, is worthy of note in that it coincides with what Melchior has recently reported as acute primary serous peritonitis.

As it has been more or less obscured in the tabulated findings, a very brief summary is necessary for identification.

An unmarried woman of twenty-eight with a history of tonsillitis terminating ten days previously was suddenly seized with chills, fever and indefinite abdominal distress. Twenty-four hours later she appeared extremely toxic with a temperature of 103 and 40,000 leucocytes. The abdomen was distended and there was demonstrable fluid. As the cardiorenal function was not impaired this was thought to be exudate. At operation the peritoneum and viscera were negative on careful examination, but 1500 c.c. of clear sterile fluid was drained from the abdomen. Recovery was uneventful.

In conclusion there are a few statements based upon these observations which at least appear to be justifiable.

The acute fulminating forms of primary peritonitis can rarely be diagnosed until in a terminal stage, while the more slowly developing cases incidental to disease elsewhere should be more frequently recognized. Also in the presence of infectious diseases or signs of sepsis a distended abdomen, particularly one with demonstrable fluid, should be strongly suggestive of peritonitis.

As to the treatment there is little choice. I have operated on four cases and two have survived, and I am naturally inclined to this course in the face of the one hundred per cent. mortality from other methods.

Certainly Murphy's dictum that expectant treatment in appendicitis was expectans mortem, is equally true here.

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RECENT CONTROVERSIAL QUESTIONS IN GALL-BLADDER SURGERY*

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In a number of papers on the surgery of the gall-bladder written during the last two or three years, certain assumptions regarding etiology, symptomatology and morbid anatomy are frequently made. It is taken for granted that the removal of the gall-bladder is not accompanied by any untoward after results and that, the gall-bladder once removed, there is no likelihood of reinfection of the common duct or the formation of stones. It is assumed that there is a causative sequence in certain lesions, chronic appendicitis being followed by hepatitis, hepatitis by cholecystitis. The infected gall-bladder is considered a focus from which infection is carried through the lymphatics to the liver and pancreas. The formation of stones is said to be but a symptom of the disease and to have little significance in the course of the disease or the spread of the infection. Cholecystitis is said to be a disease of youth. Marked morbid changes in the gall-bladder and cholelithiasis of the middle-aged, it is asserted, have been preceded by masked attacks of cholecystitis. It is assumed that there are no latent gall-stones or cholecystitis and that careful inquiry will always elicit symptoms of very mild attacks of epigastric pain, eructation of gas, pyrosis, abdominal distention, inability to eat certain foods, etc.; that by the recognition of these mild cases and by the performance of cholecystectomy in the young people of to-day the patients with advanced lesions of the biliary tract twenty years from now will be eliminated. Not only are mild attacks of cholecystitis said to give symptoms, but the hepatitis accompanying it is supposed to cause autointoxication and recurrent bilious attacks and these again are cured by removal of the gall-bladder.

In a word, it is taken for granted that a patient is spared years of ill health by removing a slightly infected gall-bladder and that changes in the wall of the gall-bladder, so slight that they can only be detected by histological examination, furnish a focus from which infection spreads to neighboring organs and justify a cholecystectomy.

I have thought it might be of interest to study these assumptions, to weigh the evidence as we have it for and against accepting them.

The material I have used for analysis and review consists of two hundred and twenty-nine cases of cholecystectomy for cholecystitis, in which the lesion was confined to the gall-bladder, and thirty-eight cases in which there was a complicating choledochitis or cholangitis, done by the surgical staff at St. Luke's Hospital during the last two years; the Follow-up report on three hundred and twenty-one patients on whom operations had been performed

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either on the gall-bladder or the common duct; and the autopsy records where lesions of the biliary tract are recorded.

The first cholecystectomy was done by Langenbuch, July 15, 1882.[1] Since then thousands of gall-bladders have been removed. There has been ample time and abundant opportunity to study the disturbance of function and alteration of structure caused by its removal. The subject has been studied experimentally for a much longer period. Zambeccari began these investigations by removing the gall-bladder in an animal over two hundred and fifty years ago, and it was well established when Langenbuch removed the gall-bladder that its absence in animals was not accompanied by any serious disturbance. The attempt has been made to draw conclusions from comparative anatomy and from rare instances of congenital absence of the gall-bladder. Much of the experimental work has been repeated with conflicting results and the exact functions of the gall-bladder are still in doubt. However, there is a general agreement among physiologists that gall-bladder bile is more concentrated than hepatic bile and that the gall-bladder acts as a current regulator for the flow of bile into the duodenum, that is to say, the presence of the gall-bladder does modify the bile and does influence its rate of flow into the duodenum.[2] After the gall-bladder is removed, since the liver secretes bile continuously, the bile must pass into the duodenum as soon as the distention of the common duct exerts sufficient pressure to overcome the sphincter of Oddi, and in animals the common duct and hepatic ducts have often been found dilated up to the point where they emerge from the liver after the removal of the gall-bladder. In many instances this dilatation is accompanied in time by a loss of tone in the sphincter muscle placed about the termination of the common duct and the flow of bile is continuous into the duodenum.[3]

There is no more curious chapter in comparative anatomy than the one that records the vagaries of this diverticulum of the excretory duct of the liver; for as a diverticulum, not as a bladder, it must be considered from the point of view of development. The gall-bladder is not present in the horse, ass, zebra, tapir, rhinosceros or the elephant. It is absent in the true deer but present in the closely related musk deer. Owen found a large gall-bladder, bifid at the fundus, in a female giraffe. In two males subsequently dissected there was not a vestige of gall-bladder. The hog has a gall-bladder while its New World relative, the peccary, has it not.[4] I shall not attempt to follow the presence or absence of the gall-bladder in the various vertebrate orders except to call attention to the fact that its absence is not noted in carnivora where food is taken at long intervals, but is noted in the vegetarian mammals in which digestion is carried on nearly continuously without marked interruption. Its congenital absence in man is rare. I give an instance taken from our autopsy records:

The child, one year old, was normally developed and well nourished and had had an uneventful history with no record of illness until four days before her admission, when she had an attack of diarrhœa. The symptoms improved, but after a week in the hospital

she died rather suddenly. At autopsy it was decided that death was due to a small patch of bronchopneumonia and to an exudation of pus in the left pleura. This was small in quantity but widely distributed over the entire pleural surface. On lifting up the liver not a trace of gall-bladder could be seen nor any evidence of previous inflammation. The *common duct* was *not* dilated, the papilla of Vater was normal in size and position. The hepatic ducts were somewhat anomalous as there were two small ducts from the right lobe which joined the common trunk below the three which proceeded from the left lobe. The hepatic artery and portal vein were normal. There was a slight groove in the liver marking the right margin of the quadrate lobe. The pancreas was normal. Other deformities or abnormalities were not found.[5]

For a number of years observations have been recorded which seem to show a diminution in the acid reaction of the gastric contents after the removal of the gall-bladder or after morbid changes which destroy its function as a bile reservoir,[6] and several observers have mentioned a slight transitory diarrhœa in which there are several stools passed made up entirely of bile, but the wonderful power of adaptation possessed by the body seems to mask or compensate for changes in function which its removal causes and the symptoms that patients suffer after cholecystectomy are apparently not due to changes in functions, the result of the absence of the gall-bladder.

In recent papers, however, there are rather widespread acknowledgments of occasional difficulties, dependent not on functional derangement due to the absence of the gall-bladder, but incidental to its removal. Not only have there been papers on reconstruction of the common duct, many of them due to injury done during cholecystectomy, but there have also been a number of papers dealing with the anomalies and variations in the arrangements of the cystic duct, cystic artery, hepatic artery and common duct.[7] Some of these have been frankly prompted by a narrow escape from injury to the duct. In several instances actual injuries have been reported by operators of wide experience, nor have the injuries been confined to operations performed for far advanced lesions, but have occurred when doing a simple cholecystectomy. There have also appeared, since cholecystectomy became so frequent, a number of papers urging the closing of the abdominal incision without drainage, the reason being given that adhesions were avoided; a confession that post-operative adhesions have been a real source of trouble.[8]

In our Follow-up results we have found eighty-four per cent. of patients after cholecystectomy free from all symptoms. We have asked them especially concerning epigastric pain, indigestion, vomiting and loss in weight. Of the sixteen per cent. giving symptoms, over half complain of more or less epigastric pain and discomfort in the neighborhood of the scar. This pain varies from slight discomfort to a very real disturbance and is at times accompanied by a feeling of distention. Gastric symptoms, distention, inability to eat certain food, nausea and vomiting are by no means infrequent; symptoms so similar to those given as characteristic of gall-bladder disease that it is difficult not to assign them to some other cause than infection of the gall-bladder wall. In several instances there has been pronounced inter-

ference with normal emptying of the stomach. Nor has there been a relation between the severity of the lesion in the gall-bladder and these gastric symptoms, nor has the attempt to close the abdomen without drainage avoided this difficulty. There is much evidence that now and again bile leaks from the cystic duct, even after it has been carefully isolated and ligated. We have closed the abdomen after cholecystectomy without drainage thirty-five times. In one patient, on the twelfth day, without premonitory symptoms there was the discharge of a considerable collection of bile. The bile had evidently been slowly leaking, had been shut in by adhesions and had finally escaped externally. In another case closed without drainage the patient made a good recovery and went home. In a few months she returned with pronounced gastric symptoms. X-ray examination showed a six-hour gastric retention after a barium meal. At operation no lesion was found in the stomach, but dense adhesions bound the stomach and duodenum to the liver, kinking and obstructing the pylorus. Doctor Downes, whose patient it was, tells me he has rarely encountered in a gall-bladder case more dense adhesions. He attributed the condition to the irritation of the peritoneum from a leakage of bile; certainly absence of drainage had not prevented adhesions.

A few years ago there was much discussion as to whether cholecystectomy or cholecystostomy gave fewer adhesions. I think it was generally decided that there were more after the drainage than after the removal of the gall-bladder. Extensive adhesions do occasionally occur, giving very real symptoms, after even simple cholecystectomy and cholecystostomy.

In thirteen per cent. of those that had post-operative symptoms there have been attacks of jaundice, vomiting and signs of intermittent infection. That is, in two per cent. of the patients on whom a cholecystectomy was done there was evidence of interference with the flow of bile through the common duct. In this group, three, or a little less than one per cent., have come back for operation for stones in the common duct.

The question of the formation of these stones in the common duct has been much discussed. In the majority of patients the symptoms appear too soon to suggest their formation in the common duct. Moreover, if the impacting stone in the common duct be removed, it often shows evidence of being made up of a nucleus looking like an old gall-bladder stone and laminated new deposits. Behind the impacting stone, numerous stones frequently form in the common and hepatic ducts. In our series we have had no instance in which we could not explain the presence of a stone by one overlooked at the time the cholecystectomy was performed. How often stones occur in the common duct that give no symptoms has been variously answered. Kehr [9] makes the rather astonishing statement that in doing cholecystectomies he has found stones in the common duct in twenty per cent. of his cases in which there was not the slightest sign of their presence; neither jaundice nor intermittent temperature. Moynihan [10] records two instances in a hundred where stones were found in the common duct without jaundice. Certainly small stones in the common duct are frequently overlooked in doing

cholecystectomies and most of the recurrences are due to this cause. Even when there are unmistakable symptoms of stone in the duct they are overlooked. Kehr *l. c.* states that he counts on overlooking one in about two per cent. of his cases. This admission from an operator of wide experience who had almost an obsession regarding the drainage and exploration of the common duct is significant.

In this connection there is an interesting point in comparative pathology. Horses have no gall-bladder, yet occasionally they die of infective cholangitis and impacted stones in the common duct. I quote from an autopsy report:[11]

"On incising the right lobe of the liver a yellowish, penetrating, stinking fluid escaped. The gall-duct was greatly thickened. In the left lobe the gall-ducts were much dilated and their walls three-quarters cm. thick. Little gall-stones were found throughout these ducts to the number of several hundred. In the chief exit there was a yellowish stone as big as a pigeon's egg. Its long diameter measured four cm."

Some years ago I remember reading the notes of an autopsy on an elephant. The animal had died of a common duct stone. I cannot now find this reference, but in Quinke's[12] monograph on diseases of the liver he writes of the occurrence of gall-stones in animals that have no gall-bladder, for example, the elephant.

I repeat the points which I wish to emphasize. Although patients after cholecystectomy maintain excellent nutrition and are free from symptoms, adhesions often follow the removal of the gall-bladder. These adhesions occasionally derange the normal operations of the pylorus and duodenum, causing pain and vomiting. Injury to the common duct has occurred often enough to suggest that the operation of cholecystectomy has at times considerable technical difficulties.

Stones which give no symptoms of their presence or give symptoms that are overlooked are not infrequently left in the common duct when the gall-bladder is removed for cholecystitis with cholelithiasis, especially in long-standing lesions. Stones very rarely form in the common duct after the gall-bladder is removed. Secondary stones frequently form in the common duct and hepatic ducts when a gall-bladder stone has become lodged in the common duct. These are reasons offered against removing the gall-bladder for slight lesions and in favor of removing all gall-bladders when stones are present or there is a well-recognized lesion.

In 1915, C. H. Mayo[13] reported that fifty-three per cent. of the patients on whom cholecystostomy had been done for cholecystitis were without symptoms. All had been observed for more than a year. Recently Cullen[14] has reported the results in two hundred and ten patients on whom cholecystectomy had been done for cholecystitis. Many of them had been observed over a period of years. One hundred and sixty-eight were well and free from all symptoms. It is fair to say that if there had been an infection in the wall of the gall-bladder or an infection of the pancreas and liver, it had subsided with drainage, without the removal of the infected gall-bladder wall. Cullen, however, writes: "In 1915, I had my own gall-bladder drained

after the removal of a large number of stones; later on more stones formed and the gall-bladder was excised." Some years ago I was acting as assistant in a hospital where the Senior Surgeon did not believe in cholecystectomy. Several times I removed gall-bladders after a cholecystostomy had failed to cure the patient. I gained the impression that a patient with cholecystitis and cholelithiasis would recover if the stones were removed and the gall-bladder drained, provided the cystic duct was not blocked. It was the uncertainty of the patency of the cystic duct, the inability to be sure that all the stones were removed, the recurrence of infection and formation of new stones if there was stagnation of bile, that made cholecystectomy preferable to cholecystostomy, although at that time, fourteen years ago, cholecystostomy was the operation of choice in many of the larger hospitals. The infected gall-bladder wall in these drained cases remained, undoubtedly containing many bacteria. Many of the patients gave evidence of infection of the common duct with the well-recognized symptoms in the liver and pancreas. But if there were no infection in the common duct, they did not develop pancreatitis or hepatitis recognizable clinically, nor was there persistent infection of the common duct unless there was a stone there or obstruction. It was recognized then, as now, that if the occlusion in the common duct was intermittent, infection almost certainly occurred. It was also recognized if the obstruction in the common duct was removed and drainage established that the infection frequently subsided and did not recur.

Two years ago Graham [15] read a paper on "Observations on the Pathogenesis of Infection of the Biliary Tract." His views have been widely accepted. He points out that there are numerous lymphatic vessels passing from the gall-bladder to the liver, that in the infected gall-bladder the maximum reaction to infection is found in the deeper layers of the gall-bladder wall, that there is hepatitis present in most infections of the gall-bladder and that the cholecystitis is usually secondary to hepatitis. In a patient on whom he was operating for appendicitis he removed a specimen from the liver and found hepatitis present. He refers to a widely accepted view that there is a close etiological relation between appendicitis and cholecystitis. He believes that from the appendix usually, or from some other portion of the portal system, bacteria enter the portal vein, are carried to the liver, lodge there, set up a hepatitis of sufficient severity to infect the lymphatics that pass from the liver to the gall-bladder and that thus the wall of the gall-bladder is infected; that the infection subsides in the liver but the liver soon becomes reinfected from bacteria that are growing in the wall of the gall-bladder and that pass again through the same lymphatics to the liver substance.

Now it has long been recognized that there are numerous lymphatics passing between the liver and the gall-bladder. They are admirably shown in *Sappey's Atlas*, published in 1874. His plates have been widely copied in text-books of anatomy. That in certain infections (appendicitis, infected

thrombosed piles, infection of the umbilical vein in infants) a progressive septic thrombophlebitis occasionally is set up and that numbers of bacteria pass to the liver in the portal blood and that lesions of all degrees of severity occur and that in some instances the infections may pass to the wall of the gall-bladder, is well known. I give the details of a case taken from a recent autopsy record:

"A child, ten years old, very ill, was admitted to the hospital. She had a high temperature, tenderness and an indistinct feeling of mass in the right hypochondrium. The abdomen was opened, the liver was found enlarged, the gall-bladder seemed acutely inflamed. It was removed. The patient died in three days. At autopsy there was only a small amount of serous fluid in the upper part of the abdomen. There were no signs of peritonitis. The liver was enlarged and riddled with abscesses. There was an early parietal clot forming in the portal veins. Section of the gall-bladder removed at operation showed a subacute cholecystitis. Although the liver was filled with abscesses, some of them but a few centimetres from the gall-bladder, only enough infection had passed through the lymphatics to set up a subacute lesion. Cultures from the pus in the abscesses showed colon bacilli."

If infection of the gall-bladder has persisted there is usually an infiltration in the cellular tissue about the gall-bladder. In chronic cases it is often necessary to sever by sharp dissection this dense cellular plane and to dissect out the gall-bladder from it. If the manipulations are at all rough the gall-bladder and adherent cellular tissues tear away the friable underlying liver substance. This is the layer in which are situated most of the lymphatics. Chills, fever and signs of general infection are not common in uncomplicated suppurative inflammation of the gall-bladder. Liver abscess occasionally occurs, but only where the gall-bladder has ruptured into the liver substance. We have frequently been impressed with the lack of relation in the morbid anatomy and the clinical signs in these patients. The lymphatics seem largely obliterated and blocked.

During the course of acute appendicitis, cholecystitis and hepatitis are not usually recognized. The associated acute lesions occur, but they are not common. Wharton [16] reported such a case in 1909. A boy, aged thirteen, was operated on for a gangrenous appendicitis. Subsequently he was operated on again for intra-abdominal abscesses, and on the twenty-second day two hundred c.c. of pus was evacuated from an acutely inflamed and distended gall-bladder. No stones were found.

I do not find in patients operated on for acute suppurative appendicitis any disproportionate number later developing chronic cholecystitis. Nor do the autopsy records on patients dying of acute appendicitis as a rule show lesions of the liver. Tens of thousands of microörganisms are undoubtedly lodged in the liver, just as they are in the spleen and the bone-marrow in general sepsis from acute appendicitis. They are taken out of circulation and many of them are destroyed in these situations.

In the experiments that Graham details to prove the sequence of lesions—portal infection, hepatitis, cholecystitis—he injected four to six c.c. of twenty-four-hour broth cultures of staphylococcus aureus into the portal veins. Such massive contamination of the portal blood is only comparable to acute infec-

tions as seen clinically. No one seems much concerned, however, with the association of the acute appendicitis and cholecystitis. It is chronic appendicitis that is in question; all cases being so grouped in which there is evidence of antecedent inflammation, whether these acute lesions have been completely cicatrized or not, whether the interval since the acute lesion has been months or years and whether the acute or subacute phase has been of very slight extent and of very short duration. This association of chronic appendicitis with cholecystitis and duodenal ulcer was advanced and supported by the work of MacCarty [17] at the Mayo Clinic in 1910 and is based on examination of a very large number of appendices (5584) removed at operation. He writes: "Examination of the appendices removed in association with 'pyloric spasm,' gastric and duodenal ulcers, cholecystitis and cholelithiasis, shows that there is a higher percentage of appendices with partially or completely obliterated lumina in all of these conditions, than at general autopsy or at operation for appendicitis." I give our own findings in Table IV. It is based on too small a number of cases to be of much value. That statistical information of this sort is misleading is notorious. How the bacteria pass from one of these chronic lesions into the portal circulation neither MacCarty nor Graham states.

In 1917, Rosenow [18] extended his interesting theory of specific strains of microörganisms with special elective affinity for certain tissue to include this group. He believes that the microörganisms are carried by the blood stream. He writes: "Appendicitis, ulcer of the stomach and duodenum and cholecystitis are largely embolic infections from some distant focus of infection or even from the more or less normal intestinal tract, by streptococci or other bacteria having elective affinity for these structures and the presence of two or more of these diseases in the same individual is in the beginning due more often to this cause and not so often to infection by continuity or by the way of the lymphatics." His views do not suggest a causative sequence but a common cause for the associated lesions. Unfortunately other observers have not been able to confirm his claim. Zinsser,[19] in his text-book of bacteriology, definitely states that he does not believe it. He writes: "It is an interesting thought, yet a dangerous one to spread broadcast, since it has influenced clinical thinking to an extent not warranted by experimental fact." Rosenow, in the course of his experimental work, found a striking difference in the character of the lesions following injection of streptococci and colon bacilli. When streptococci were introduced the lesions were largely in the muscular coat and serosa of the gall-bladder. When colon bacilli were introduced the mucous membrane was often necrotic and sloughing and the peritoneal and muscular coats but slightly involved.

Possibly the organisms enter the portal circulation by the process spoken of by Adami [20] as sub-infection. Phagocytes about any focal infection are constantly taking up bacteria and are then finding their way back, through the endothelium of the capillaries, into the circulating blood. Adami believes that

many are carried into the portal circulation from the intestinal mucosa even when there is no lesion, but a superficial catarrh of sufficient severity to make a slight cellular exudate. He believes he has evidence that these organisms are being constantly destroyed by the liver cells and that, under certain conditions, they may set up low grades of hepatitis and chronic nephritis. There is no proof that the hepatitis, that Graham and others who have confirmed his views have found, is not some such condition. The whole subject of hepatitis and cirrhosis is considered by pathologists, I think, an uncommonly difficult one. It is certainly difficult to discuss clinically when the same term is used for a very slight infiltration of the liver substance by polymorphonuclear leucocytes, suppurative hepatitis and terminal stages of liver cirrhosis following the destruction of the hepatic cells by various toxins and their replacement by connective tissue.

About a gall-bladder, extending beneath the serosa, and especially between the liver and the gall-bladder, is a layer of cellular tissue in which are situated lymph capillaries communicating with the lymphatics of the liver and in which are embodied the collecting lymphatic vessels which pass to glands situated at the neck of the gall-bladder and at the pancreatic-duodenal junction. This cellular plane is continuous with that covering the pancreas. As Huxley [21] so well expressed it many years ago: "So completely and thoroughly does the connective tissue permeate almost all parts of the body that, if every other tissue could be dissected away, a complete model of all the organs would be left composed of this tissue." Whenever infection takes place it is infiltrated and much swollen and the zone of swelling extends from the focus according to the severity of the infection and the reaction of the tissues. This is as true for an infected gall-bladder as an infected finger. In acutely infected gall-bladders the cellular tissue between the gall-bladder and the liver is succulent and swollen and there is infiltration of the contiguous portions of the liver. There is frequently present swelling and infiltration about the neck of gall-bladder and the pancreas. But there are usually no clinical signs, after the removal of an infected gall-bladder or even its drainage, of persistent pancreatitis or hepatitis. There is usually prompt recovery. A conspicuous feature in many cases is the rapid gain in weight and the excellent nutrition of these patients, conditions hardly compatible with persistent pancreatitis or hepatitis. And as Judd [22] writes in a recent article: "Even if there is much pus in the gall-bladder, or it has become gangrenous, severe infection is unusual in the pancreas." Acute pancreatitis, to be sure, is given as the cause of death determined by autopsy in a case reported by Whipple [23] when the lesion was confined to the gall-bladder wall, but this seems an exceptional finding. The mortality is low in infections of the gall-bladder uncomplicated by infection of the common duct and bile passages. In Whipple's series of one hundred and seventy-five cases it was less than one per cent. In the series reported in this paper it is over one per cent. (1.7 per cent.). There were eleven deaths in eight hundred and

ninety cholecystectomies recently reported from the Mayo Clinic (1.2 per cent.).[24]

If, however, there is even slight obstruction to the common duct, and especially if this obstruction is intermittent, infection of the common duct regularly follows and the infection soon travels to the bile capillaries and a hepatitis is present. The anatomical relation of the pancreatic and the common bile duct is such that no matter what the arrangement of the two ducts, whether they are double-barrelled and open separately into the duodenum, whether they open into a common ampulla or whether there is an accessory duct, it is difficult to think of much swelling or occlusion in the transduodenal portion of the common duct without the pancreatic duct being compromised. I am not referring to the possible backing up of bile in the pancreatic duct by a stone in the terminal portion of the common duct, apparently an uncommon occurrence, but to the possibility of intermittent occlusion of the pancreatic duct and the phenomena of infection in glandular tissue which would be expected to follow; for the readiness with which all glandular tissue becomes infected when there is intermittent occlusion is well recognized. The kidney, the salivary glands, the lactating mammary glands and the liver, all furnish examples. Whipple reported eighteen cases in which he had noted a curious condition which he described as pancreatic asthenia; six were carcinomata and of the remaining twelve, six had at operation a stone in the common duct. Sistrunk,[25] two years ago, reported four cases of stone in the pancreatic duct. In one there were at the time of operation stones in the common duct. He attributes their formation to stagnation of secretion and infection.

There is evidence then, from autopsy findings, that marked suppurative lesions of the liver, from infection carried by the portal vein, are accompanied by moderate infection of the gall-bladder wall. There is evidence that suggests marked chronic suppurative inflammation of the gall-bladder is often associated with blockage of the lymphatics and but slight infection of the neighboring portion of the liver. There is very slight evidence that microorganisms pass into the portal circulation from an obliterated appendix in sufficient quantities to set up any of the clinical forms of hepatitis or cholecystitis. It has long been known that there are frequently low-grade infections or sub-infections of the liver. It has been suggested that leucocytes, at times containing attenuated microörganisms pass into the portal circulation through the intact mucous membrane of the bowel or through small lesions and set up these sub-infections. There is some evidence of such sub-infection of the gall-bladder wall. The clinical forms of pancreatitis and hepatitis are well known to be frequently associated with infection of the common duct. These are very infrequent when the infection is confined to the gall-bladder wall.

It has been said that if one makes careful inquiry in patients in whom gall-stones are discovered during the course of a laparotomy for some other condition there is nearly always a past history of epigastric pain or the

symptoms of a special form of indigestion which is associated with cholecystitis and cholelithiasis.[26] These symptoms are eructation of gas, a feeling of distention, discomfort and pain on eating certain foods, a condition often spoken of as "qualitative food dyspepsia." However, they have been found conspicuously absent in several instances where I have left a gall-bladder in place in which stones had been distinctly palpated during the operation for fibromyoma of the uterus. Moreover, there are no inconsiderable number of patients in whom a first attack of typical biliary colic is not preceded by any symptoms and this is occasionally true between the attacks. They are conspicuously well nourished with hearty appetites and contented countenances. I have one such case under observation at present. The patient, a man forty years old, had had two typical attacks of biliary colic. At operation he had chronic cholecystitis, numerous small stones in the gall-bladder and one in the common duct. The lesion gave evidence of long standing. The most careful questioning failed to draw out a single gastric symptom before the first attack or between the attacks. He had neither nausea nor vomiting, belching of gas nor inability to eat certain foods nor epigastric pain.

It seems to me that the evidence is convincing that cholecystitis and cholelithiasis are often latent. I mean that the stone cannot be detected or the cholecystitis recognized. Here again there is an interesting observation in comparative pathology. South American cattle frequently have gall-stones; so frequently, in fact, that the Chinese and Japanese consider this a valuable source for supplying them with material from which they extract dyes for painting chinaware; yet a veterinary surgeon reports that "It is remarkable that of the hundreds of cattle which we have examined daily we have hardly ever met a case of colic among them and very few cases of jaundice."[27] In presumably healthy cattle slaughtered in this country gall-stones are uncommon; roughly speaking, there are fifty pounds of gall-stones exported to the Orient from the slaughter of two million cattle.

Now we have no means of knowing just how often young people have slight changes in the gall-bladder wall. Many of the finer histological changes cannot be detected at autopsy. We do know, however, that the grosser changes and gall-stones are uncommon in the young. They occur, but not commonly. Kellogg[28] reported a case in a child eleven years old and collected sixty-four from the published reports during the last one hundred years.

Gall-stones are made up of cholesterin alone or the combination of cholesterin with calcium salts of bilirubin. It is known that bile stasis and infections of low virulence are the chief factors in their production and that, given these conditions, they can be produced experimentally in animals. It is recognized in a small percentage of cases that radiate cholesterin stones are found without evidence of infection and that hindrance to the outflow of bile due to adhesions, kinking or congenital peculiarities[29] is the important initial factor in the inspissation of bile and the precipitation of its solids. Furthermore, when stones have once formed they soon have the significance

of an infected foreign body. Infected foreign bodies cause infection to persist. They seem to make it difficult for the bactericidal properties of the cells to kill the microörganisms implanted with them and they furnish an effective means of conveying infection and lodging it elsewhere. In the ducts of glandular tissue their effect in causing blockage and infection is generally recognized and their mechanical presence is a cause of tissue necrosis and perforation. It is very difficult to study the morbid anatomy and symptomatology of cholecystitis without taking into account cholelithiasis. The statement that stone formation is but an incident in the infection of the gall-bladder is misleading. Under the influence of infection they form much more rapidly, I think, than is usually assumed. A recent observation of Cameron [30] is interesting. An acutely inflamed, distended, thin-walled gall-bladder was opened, carefully inspected and drained; no stones were found. Eighty-six days after the cholecystostomy the gall-bladder was removed. It was contracted, with thick walls and contained thirty-eight calculi.

There must be a period in the chain of events leading to the formation of calculi when the infection is very slight; periods when a temporary obstruction has passed away and the morbid changes in the wall are disappearing. The question arises in these slight lesions, how are we to determine, which ones will resolve and which ones will go on to stone formation. Are we to remove all gall-bladders in operations in which the laparotomy has been done for pain in the epigastrium and gastric symptoms? Slight thickening of the wall, distention of the gall-bladder, thick and tarry bile and bile with a foul smell, enlarged lymphatic glands near the cystic duct, the alteration in the mucosa known as strawberry gall-bladder, are all given as indications for cholecystectomy. Obviously, in any of these alterations it must be a question of nice judgment to determine when the morbid anatomy is sufficiently advanced to warrant removal.

Several years ago I operated on a middle-aged woman who had had attacks of abdominal pain and gastric symptoms. The pre-operative diagnosis was cholecystitis with cholelithiasis. I found a gall-bladder without demonstrable lesions and removed the appendix only. Eighteen months later she returned with typical biliary colic. The gall-bladder was removed; it contained several stones. I had overlooked, at the first operation, a cholecystitis of sufficient severity to lead to the formation of calculi and pronounced clinical symptoms within eighteen months. On the other hand, I have several times removed the gall-bladder in patients on whom a diagnosis had been made of cholecystitis and who had no stones and slight morbid changes in the gall-bladder wall and who have not been benefited. I recall one who has had more violent pain and more gastric symptoms since the operation than before. The histological examination in this case showed evidence of slight chronic cholecystitis. That the milder degree of cholecystitis, when subjected to operation, will not present a high percentage of cures, was the opinion of W. J. Mayo [31] ten years ago.

There should be very strong reasons for departing from the sound surgical principle that an organ should not be removed unless there is an obvious lesion. Rules applicable for lesions of the appendix do not hold good for the gall-bladder. The sequence of morbid changes in the gall-bladder is very different from the sequence in the appendix. In the gall-bladder the course is slow; perforation into the free peritoneal cavity is very rare.[32, 33] The microörganisms are in most instances of low virulence. Gangrene and local necrosis are late, not early lesions.

There is much evidence being accumulated that very slight lesions and attenuated microörganisms are not infrequently found in the gall-bladder wall. None of the clinical tests available enable us to detect these slight lesions. We are told we must rely on the history. The history of biliary colic is characteristic, but I cannot believe that the gastric symptoms alone furnish an equally characteristic picture of cholecystitis.[34] These symptoms, to some degree, are present in a large percentage of the human race; for example, regurgitation, acid eructation and accumulations of gas are very common in the middle-aged and the inability to eat certain food is almost universal. There is a saying over two thousand years old that "One would laugh at anyone over thirty who would ask counsel of others concerning matters of diet." I have found the same symptoms, on careful inquiry, in patients who had a cholecystectomy and who report themselves well and free from discomfort; they are absent in a considerable group that have well-marked cholecystitis. Gastric symptoms are often found accompanying infections of the gall-bladder, but they are by no means always present, nor are they so characteristic that it is justifiable to remove the gall-bladder without obvious and demonstrable lesions, for these symptoms alone.

Drainage of these mild cases of cholecystitis is notoriously unsatisfactory. If one wishes to convert a slight lesion of the gall-bladder wall with no adhesions into a well-marked lesion with many adhesions, he can not infrequently do so by inserting a drainage tube into the gall-bladder. That these slight lesions set up pancreatitis and hepatitis sufficient to be recognized clinically is questionable. There is nothing to support the contention that lassitude, malaise and biliousness in young people are due to hepatitis and are cured by the removal of the gall-bladder. We have no assurance if we removed all the gall-bladders in all the long-bodied, anæmic young people who complain of pain in the abdomen, capricious appetite and lassitude that in twenty years we will not have an equally large group of patients with cholecystitis and gall-stones in the conspicuously well during adolescence from the same community. The notion that we must excise tissue because bacteria are occasionally found there or because there is evidence that the tissues are destroying bacteria or that the cells are responding to an irritant, does not seem to be justified. I have operated on several old women, one over eighty-five, during the last three years. The lesions in the gall-bladder wall were far advanced. They gave a history of attacks dating back many years. If

the common duct was not involved they gave no history of years of invalidism. They had led active lives. Three, except during the attacks, were conspicuously well old women.

I am reminded, in reading several of the recent papers, of the surgeon in Mr. Shaw's play, "The Doctor's Dilemma." Mr. Cutler Walpole was rich, able, skillful and confident. He believed ninety-five per cent. of the human race had a nuciform sac and that he was the man to remove it.

In Conclusion.—There have been no reports of serious interference with function or loss of nutrition following the removal of the gall-bladder, although thousands have been removed during the last forty years.

There are occasional reports of damage done to the common duct during simple cholecystectomy, even by operators of large experience.

The removal of a slightly infected gall-bladder or its drainage is accompanied at times by extensive adhesions fixing the pylorus or the duodenum to the under surface of the liver and giving symptoms of interference with the functions of these organs.

The proof that the gall-bladder should be removed for very slight lesions of the wall, accompanied by symptoms of indigestion, seems to me not yet sufficiently established.

It goes beyond demonstrated fact to assume that slight degrees of cholecystitis do not resolve.

The prophylactic removal of a normal gall-bladder does not seem justified.

The proof is not convincing that the majority of infections of the wall of the gall-bladder, sufficient to give symptoms, represent a direct extension to its walls from an inflamed liver through the lymphatics.

That bacteria enter the portal circulation from an obliterated appendix in large enough numbers to produce a hepatitis and cholecystitis recognizable clinically is by no means established.

In the very large percentage of cases of cholecystitis cholelithiasis must be considered as an important factor in determining the initial lodgment, the persistence and the transference of the infection.

Autopsy records and clinical experience furnish abundant evidence of the very slow progression of lesions in the gall-bladder.

The removal of the gall-bladder for gall-stones and well-marked lesions of the gall-bladder wall, uncomplicated by lesions of the common duct, is accompanied by a low mortality and by excellent results.

There is little clinical or autopsy evidence of the association of persistent hepatitis, cirrhosis or pancreatitis when the disease is confined to the gall-bladder wall.

Common duct stones, choledochitis and cholangitis are late lesions and have a high mortality, and patients should come to operation before these lesions develop.

TABLE I.

Mortality Statistics in 229 Cases of Cholecystectomy. In 229 Cases There Were 4 Deaths, or 1.7 Per Cent.

1. Died of pulmonary embolus ten days after operation.
2. Died twenty-six days after operation. Diagnosis at autopsy: Cholecystectomy with abscess in gall-bladder bed and abdominal wound. Cerebral hemorrhage. Infected infarct of left lung. Bronchopneumonia. Arteriosclerosis. Chronic nephritis.
3. Worn out, dehydrated woman. Temperature rose rapidly after operation. Died on third day. Temperature 107.
4. Old woman with chronic nephritis and endocarditis. Died forty-eight hours after operation. Probable cause of death: sepsis.

In 38 cases with stones in the common duct there were 9 deaths, a mortality of 23 per cent.

TABLE II.

Follow-up Report on 321 Cases of Infection of the Biliary Tract Treated by Cholecystectomy

8.4 per cent. report themselves as free from all symptoms.

Of the remaining 16 per cent.:

34 per cent. have had pain but have gained weight.
16 per cent. have had pain and lost weight.
16 per cent. have had pain, vomiting * and have gained weight.
7 per cent. have had pain, vomiting * and have lost weight.
13 per cent. have had pain, vomiting * and jaundice. (Of these, three returned to the hospital and had stones removed from the common duct.)
14 per cent. have had complications. (That is, some other illness making it difficult to classify the results.)

* Vomiting coming on in attacks and often very severe is not uncommon. For twenty-four hours almost everything is vomited. Strangely enough some of these patients have shown a marked gain in weight.

There were six hernias, or 1.8 per cent.

TABLE III.

Weight Record in 128 Gall-bladder Cases. Patients Listed as Free from Symptoms.

The weight record of a group of cases following cholecystectomy has been given to show the excellent nutrition maintained after the gall-bladder was removed, a condition which is not compatible with any serious disturbance of function, or persistent lesions in pancreas or liver. Ninety per cent. gained weight; 10 per cent. lost weight.

The actual weight in 102 cases in the months observed are as follows:

Amount of weight gained lbs.	Months observed
5	48
20	12
15	15
17	30

Amount of weight gained lbs.	Months observed
12	30
4	28
11	18
7	36
15	38
17	48
20	16
50	60
35	24
6	42
20	42
25	34
45	50
4	36
14	24
8	30
49	27
15	24
20	30
21	48
15	60
22	32
60	36
15	20
14	2
5	21
10	24
52	15
20	28
20	21
20	29
5	24
10	14
4	14
20	8
42	42
45	18
13	8
13	12
10	20
3	24
9	12
20	18
25	15
8¾	17
4	8
8	15
20	26
10	2
30	30

Amount of weight gained lbs.	Months observed
10	2
50	12
20	24
20	15
30	12
10	2
10	15
7½	36
15	21
15	60
8	30
3	34
26	12
3	10
11	60
10	30
15	20
25	36
14	44
29	40
19	54
15	32
10	31
44	36
60	60
15	24
10	18
12	24
15	39
25	60
21	18
3	48
24	60
6	12

Amount of weight lost lbs.	Months observed
10	7
4	17
13 (Intentional)	2
22	24
9	12
7	20
20	48
8	48
4	36
5	40
10 (Intentional)	24
36 (Due to other illness)	40
5	20
2	54

TABLE IV.

In a series of 174 cases in which the gall-bladder and appendix were removed, the lesions were reported as follows:

Acute Cholecystitis	Acute cholecystitis, Normal appendix	5
	Acute cholecystitis, Chronic appendicitis	5
Subacute Cholecystitis	Subacute cholecystitis, Normal appendix	9
	Subacute cholecystitis, Subacute appendicitis	2
	Subacute cholecystitis, Chronic appendicitis	11
Chronic Cholecystitis	Chronic cholecystitis, Normal appendix	53
	Chronic cholecystitis, Acute appendicitis	3
	Chronic cholecystitis, Subacute appendicitis	4
	Chronic cholecystitis, Chronic appendicitis	82

In 38 per cent. the appendix was normal.

In 62 per cent. there was a lesion of the appendix.

The reports by the pathologist taken from the microscopical findings have not in many instances agreed with the lesions as described by the surgeon at the time of the removal of the tissue; for example, the pathologist reports subacute cholecystitis and subacute appendicitis whereas the surgeon describes the same lesion from macroscopic examination as acute cholecystitis and chronic appendicitis.

For comparison, in a series of 115 cases in which both tubes and appendix were removed, the lesions were reported as follows:

Acute Salpingitis	Acute salpingitis, Normal appendix	1
	Acute salpingitis, Acute appendicitis	2
	Acute salpingitis, Chronic appendicitis	1

Subacute Salpingitis	Subacute salpingitis + Normal appendix	8
	Subacute salpingitis + Acute appendicitis	2
	Subacute salpingitis + Subacute appendicitis	7
	Subacute salpingitis + Chronic appendicitis	17
Chronic Salpingitis	Chronic salpingitis + Normal appendix	39
	Chronic salpingitis + Acute appendicitis	2
	Chronic salpingitis + Subacute appendicitis	3
	Chronic salpingitis + Chronic appendicitis	33

In 42 per cent. there was a normal appendix.
In 58 per cent. there was a lesion of the appendix.

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ANÆSTHESIA OF THE SPLANCHNIC NERVE IN ABDOMINAL OPERATIONS

By Hermann Fischer, M.D.
of New York, N. Y.

In the year 1892, Schleich published a method of local anæsthesia invented by him, and in 1894, he reported twenty-eight laparotomies which he had performed entirely under local anæsthesia. Among these cases there were three gastrostomies and two cholecystostomies. Friedlander reported in 1900, sixty-eight cases in which he had used local anæsthesia, among them were five gastrostomies, two colostomies, two ovariotomies.

In 1904, Baker reports that in his clinic, abdominal operations were done entirely under Schleich's local anæsthesia or in combination with general narcosis. In Mikulicz's clinic, as reported by Gottstein, in 1896–98, twenty-two operations upon the stomach were performed under local anæsthesia alone.

Since the appearance of these publications, local anæsthesia has gained more and more in favor among surgeons, so that now in all surgical clinics a great proportion of operations are carried out under some form of local anæsthesia. A great impetus was given to this method by the substitution for cocain of drugs which were less poisonous and equally effective and which therefore could be used in larger quantities. The standard drug at present for local anæsthesia is a one-half per cent. and a one per cent. solution of novocain in combination with or without suprarenin.

In this paper I shall not go into elaborate discussion of local anæsthesia in general, but shall confine myself to the method of anæsthesia of the splanchnic nerves in operations upon intra-abdominal organs, especially in operations upon the stomach and the biliary system.

The application of local anæsthesia on the extremities and the surface of the body was comparatively simple. The innervations of these regions were known and they were easily accessible. The moment, however, we tried to attack the intra-abdominal organs under local anæsthesia, the problem became more difficult and complicated.

The first to investigate the intricate sensory nerve apparatus of the abdominal organs was Lennander. From his investigations, he drew the conclusion that the sympathetic nervous system did not convey any sensory impulses and that all organs which were innervated by the vagus, below the origin of the recurrent nerve, or by the sympathetic, were not sensitive to pain, pressure, cold or heat. Omentum and mesentery he also proclaimed to be insensitive to pain. According to him the parietal peritoneum is very sensitive. The pains elicited by stretching and pulling on the mesentery are caused by the irritation of the intercostal nerves of the cerebrospinal system which innervate the parietal peritoneum of the posterior abdominal wall.

The results of Lennander's investigations, however, do not tally with later experimental and clinical experiences. Kast and Meltzer found that the normal intra-abdominal organs were sensitive to pain and that this sensitiveness was very much augmented if the parts were inflamed. Wilms concluded that the whole intestinal tract, as such, had no pain sensation, but that sensory impulses were conveyed to it by the fine nerve-filaments running in the mesentery along with the mesentery vessels.

Ritter believes that all abdominal organs are sensitive to pain and that the anæsthesia is not produced by the injected drug but by the action of the air upon the fine nerve filaments. Propping lays stress upon the painful sensations patients complain of when the mesenteric vessels are tied and Finsterer points out that the patients do not experience any pain when all pulling and stretching of the mesentery is avoided. A. W. Meyer states that the stomach and intestines, including their serous coats, are not sensitive to pain, that the mesentery, however, is very much so.

Mueller (1912), in his histological studies, states that according to the opinion of the authors the splanchnic nerve carries fibres of sensation. The pain which accompanies tabetic crises is another proof that there exist sensory fibres in this nerve which enter the posterior spinal roots by way of the spinal ganglia.

By the investigations of Burger and Churchmann (1915) the fact was established that irritation of the abdominal ganglia and of the splanchnic nerve are followed by severe pain-sensations.

Mueller calls attention to the fact that the character of abdominal pain during gall-stone-colic and renal-colic is entirely different from the pain which is caused by irritation of spinal nerves. Whereas the latter pain is strictly localized, the pain caused by irritation of the visceral nerves radiates through the whole vegetative system and can be associated by vasomotor disturbances, pallor of the face, flow of saliva and perspiration and elevation of blood-pressure. If these visceral pains are excessive they can become unbearable and cause the feeling of impending death as in angina pectoris.

Kappis and Naumann after experiments on dogs come to the following conclusions:

Abdominal organs have practically no sensation, for the reason that either the nerve fibres disappear before reaching the organ, or the fibres which reach the organs are too fine and too few in number. However, those regions to which the nerve fibres penetrate in sufficient number and calibre are strongly sensitive. These regions are: the mesentery, the lesser omentum, the attachment of the large omentum to the stomach, the region of the common bile duct, cystic duct, hepatic duct, and hylus of the liver, the hylus of the kidney and the neighborhood of the large vessels. The irritation travels by way of the abdominal ganglia through the splanchnic nerves, the rami communicantes of the lumbar nerves; and through all branches of the sympathetic.

The view of Laiguel-Levastine that the vagus was the carrier of abdominal

impulses, was challenged by the observations of Th. Kocher and has been definitely abandoned. The clinical and experimental experiences have confirmed Kocher's observation and to-day it is considered certain that the sympathetic alone carries sensory impulses from the abdominal organs to the cerebrospinal system.

In 1911, Kappis and Finsterer tried to achieve an anæsthesia of the abdominal cavity by blocking the communicating branches of the sympathetic by their method of paravertebral anæsthesia.

Laewen tried to popularize this method, but it never gained much favor on account of its complicated technic.

Wendling published a method of blocking the splanchnic nerve by injection from the anterior abdominal wall. He inserted the needle 1 cm. below the xyphoid process and one-half cm. to the left of the median line without taking in consideration the underlying organs, liver, stomach, pancreas, colon. Wendling had good results and reported thirty-six cases with only one failure. This method has not been followed by anybody else as the danger from injuring hollow organs with ensuing complications is too obvious.

Anatomy of sympathetic nerve: The sympathetic, vegetative, visceral or autonomous nervous system (Langley), which supplies the involuntarily active organs, can be divided anatomically as well as physiologically and pharmacologically into two large groups:

(1) The cranio-bulbar and sacro-autonomous system (by Langley called parasympathetic system).

Its fibres originate in the midbrain, in the bulb and the sacral part of the spinal column. From the midbrain the parasympathetic nerve fibres pass through the nervus oculomotorius to their end organs: musculus sphinctor pupillæ and musculus ciliaris. From the medulla oblongata or the bulbus they pass through the facial nerve, the intermediate, the glossopharyngeal and the vagus to the lacrimal, salivary and the buccal glands of the naso-pharynx; to the treachea, lungs, heart, liver, pancreas, kidneys, stomach, ileum and proximal colon; from the upper sacral part through the pelvic nerve to the distal colon, rectum, bladder and genitals.

(2) The sympathetic system proper or thoraco-lumbar autonomous system, derives its fibres from the thoracic and lumbar part of the spinal cord.

The characteristic feature of the entire vegetative nervous system is its common pharmacological reaction towards nicotine. Another characteristic is that the vegetative nerve fibres, in contradistinction to the animal nervous system, never travels directly to its endorgan, but passes into a ganglion where it is split up. From here it goes forth as a new neuron to reach its peripheral organ. This transformation takes place either in the sympathetic trunk or in the vertebral or in the prevertebral ganglia (for instance, cæliac ganglia and mesenteric ganglia). Upon these ganglia nicotine has the effect of complete paralysis after a short period of stimulation.

The sympathetic and parasympathetic nervous systems are, so to speak, pharmacological antagonists.

The sympathetic system is stimulated by adrenalin; *i.e.*, adrenalin augments the action of the sympathetic fibres, irrespective of whether they are normally augmentor or depressor fibres.

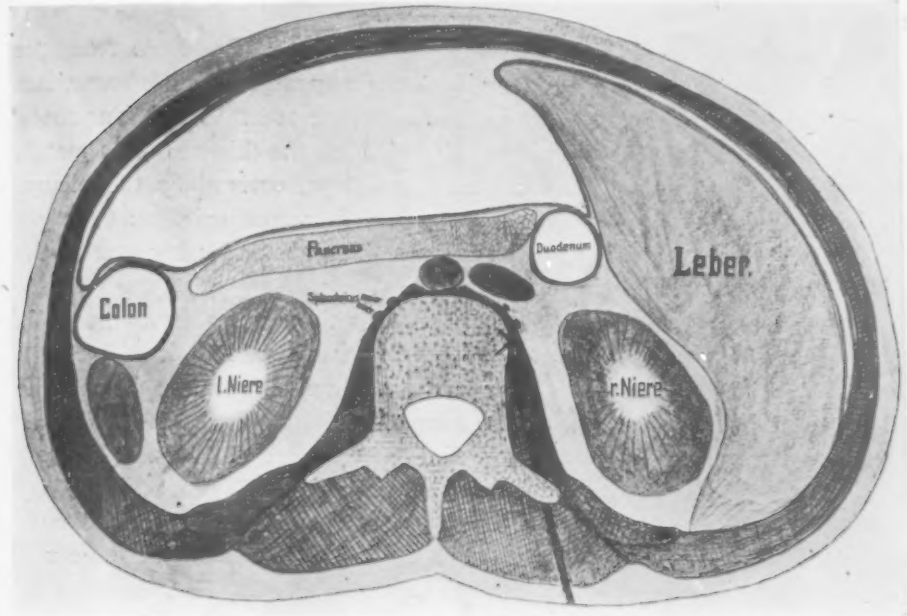

FIG. 1.—Cross section of body at the level of the first and second lumbar vertebræ to show situation of injection needle. (After Kappis.)

The parasympathetic system is depressed by atropin and stimulated by muskarine, pilocarpine, physostigmine and cholin.

Nicotine attacks the ganglia.

Atropin, adrenalin, muskarine, etc., attack the peripheral nerve endings.

Besides these two vegetative nerve systems there is in existence a third one which is autonomous. Langley calls it "enteric system" (Auerbach and Meissner's plexus for stomach and intestine). This system is imbedded in its endorgan.

The sympathetic nervous system is situated on either side of the vertebral column. It consists of the trunks of the sympathetic nerve, formed by a large number of ganglia which are connected with each other by the so-called interganglionic branches. In the thoracic and lumbar portion they are strictly arranged according to segment—one ganglion corresponds to each intercostal nerve. This segmental arrangement, however, does not obtain in the cervical and lumbar regions.

In the region of the neck there are only three, or even only two, ganglia; ganglion cervicale superius, medius and inferius.

The sympathetic trunks in the cervical and thoracic region run down on either side of the vertebral column, converging somewhat in the lower thoracic region where they run more mesially; in the lumbar region they keep to the midline in front of the vertebræ, diverge again in the sacral region. Just above the coccyx they unite, forming the ganglion impar. The sympathetic trunks communicate by the rami communicantes with the central nervous system.

The nervus splanchnicus major arises with four or five roots from the 6th, 7th, 8th, and 9th thoracic ganglia of the sympathetic trunk sometimes getting fibres from the 5th, and sometimes from the 10th. These four roots, after uniting, form the splanchnic nerve, which has the thickness of a match. It travels downward immediately on the vertebræ, covered by the pleura. It pierces the diaphragm between its crura. It is accompanied on the right by the vena azygos, on the left by the vena hemiazygos and going over to the midline terminates in the semilunar ganglia.

The splanchnicus minor arises with two or three roots from the 10th, 11th, and 12th thoracic portion of the sympathetic trunk. It pierces the diaphragm, lying laterally to the splanchnicus major, between it and the sympathetic trunk. It ends with a smaller part of its fibres in the semilunar ganglia and with a larger part in the renal and suprarenal plexus. (Fig. 3.)

The two semilunar ganglia from the solar plexus and its secondary plexus (phrenic plexus, suprarenal plexus, renal plexus, spermatic plexus, superior gastric plexus) are supplied by: (1) The two splanchic nerves. (2) The abdominal branches of both vagi. (3) Several direct branches of the lumbar sympathetic trunks.

The vagi have nothing to do with the sensibility of the abdominal organs as we know to-day. The anæsthetization of the abdominal organs can therefore only be accomplished by blocking of the splanchnics and the lumbar sympathetic trunk.

The technic of anæsthesia of the splanchnic nerve as worked out by Kappis is as follows:

The patient lies on his side with his back bent as much as possible. After disinfection of the skin a small wheal is made 7 cm. laterally from the midline just below the lower border of the 12th rib. At this place a long needle is pushed in at an angle of 30 degrees to the sagittal plane of the body. After penetrating to the depth of 6 to 8 cm. the needle strikes the lateral surface of the vertebræ. Along the lateral surface the needle is pushed forward until its point is free, it now lies at the junction of lateral and anterior surface of the vertebræ, where the splanchnic nerves and the sympathetic ganglia are situated. Twenty to forty c.c. of a 1 per cent. solution of novocain adrenalin are slowly injected. The same procedure is repeated upon the other side. In this way the splanchnic nerves are blocked on both sides. To block also the lumbar region, Kappis has recommended to inject 10 to 20 c.c. at the level of the transverse process of the first lumbar vertebra.

Lately he has changed his technic a little in such a way that he directs his needle from the point of insertion a trifle towards the head, in order to be able to reach the trunks of the splanchnics before they pierce the diaphragm. (Fig. 1.)

The frequent aspiration of blood is mostly caused by injuring the intercostal vessels. To avoid this injury, Preiss recommends pushing in the needle on either side through the intervertebral cartilage. However, one has to be a little careful not to break the needle.

The needle should be at least 12 cm. long, of 0.75 mm. calibre. Kappis also recommends, in order to reach the lumbar portion of the sympathetic trunk, the injection of 10 to 20 c.c. at the level of the transverse process of the first lumbar vertebra; this point is about 3 cm. below the first point of insertion.

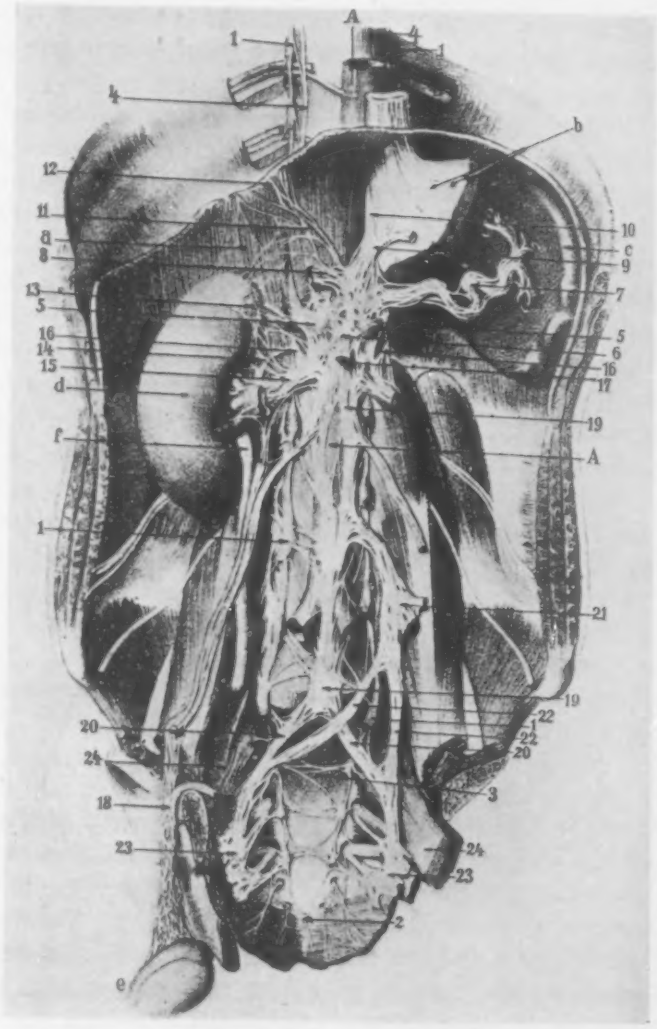

FIG. 2.—The abdominal sympathetic plexus. (From Hirschfeld and Leveillé.) A. Aorta. a. Diaphragm. b. Stomach. c. Spleen. d. Kidney and adrenal. e. Testis. f. Ureter. 1. Sympathetic trunc. 2. Ganglion impar. 3. Anastomosis of the two sympathetic truncs. 4. Splanchnicus major. 5. Semilunar ganglia. 6. Solar plexus. 7. Splenic plexus. 8. Hepatic plexus. 9. Coronary plexus of stomach. 10. Vagus. 11. Diaphragmatic plexus. 12. Branches of the phrenic nerve. 13. Plexus suprarenalis. 14. Plexus capsularis inf. 15. Plexus renalis. 16. Splanchnicus minor. 17. Pl. mesent. sup. 18. Pl. spermat. 19. Pl. lumbo-aorticus. 20. Division of same. 21. Plex. mesent. inf. 22. Anastomosis with pl. hypogastric. 24. Plex. sacralis.

Preiss has found in his anatomical studies that the best way to reach the lumbar ganglia of the sympathetic trunk is to insert the needle at the level of the third lumbar vertebra. From this point a good diffusion of the anæs-

thetic can be accomplished which reaches from the second lumbar vertebra down to the promontory.

He has tried this method so far on three patients with one failure (1 appendicitis, 1 ileus, 1 carcinoma of the pylorus with resection). He injected 20 c.c. of 2 per cent. novocain, on either side, in two cases, in the last case 25 c.c. of a 1 per cent. solution.

Although in a large majority of cases the injection from a point immediately below the lower border of the 12th rib is sufficient, in some operations on kidneys, spleen and colon the addition of the lower injection is advisable. Amount of fluid to be injected varies with different operators. Kappis originally used 120 c.c. of 1 per cent. novocain adrenalin solution. Lately he uses 100.0 of ½ per cent. solution. Wendling, 80 c.c. of 1 per cent. solution. Buhre, 100 c.c. of 1 per cent. solution. Naegele, 70.0 of 1 per cent. solution. Drimer, only ¼ per cent. solution in very small quantity, not using more than 0.5 novocain in substance pro patient. Hoffmann uses: novocain 0.5 of 2 per cent. solution, potassium sulphate 20.0 solution, sodii chloride (0.9 per cent.) ad 100.0, solution adrenalin hydrochloride (1°/oo) gtts. xii. Preiss uses the following: novocain 2.0, aqua destillata 100.0, suprarenin 0.002, sodium chloride 0.7, potassium sulfate 0.4 and injects 80 c.c. He uses 2.0 to 2.35 of novocain in substance as maximum. In spite of these large doses (0.5 maximum dose after Hoechst) he met with no signs of intoxication or collapse. No kidney irritation. Sometimes slight pallor and off and on vomiting. Blood-pressure not abnormally high or low. Preiss does not prepare the patient with other narcotics before operation, except 0.01 morphine or 0.02 pantopon.

Braun and Buhre recommend to block the splanchnic nerves from in front after opening of the abdominal cavity, in the following way: Infiltration anæsthesia of abdominal incision down to parietal peritoneum. After opening of the abdominal cavity the liver is lifted up, the stomach, if necessary, is pushed over to the left side. By palpating with the index finger the anterior surface of the lumbar vertebræ is sought for. The aorta is pushed towards the left side and the needle pushed down to the anterior surface of the vertebræ, here 100 c.c. of ½ per cent. of novocain adrenalin is deposited. Anæsthesia follows almost immediately after injection. Drimer recommends to inject above the small and large curvature of the stomach, in the region of the cæliac axis, in the region of the duodenum and the pedicle of the liver, and in the region of the superior and inferior mesenteric vessels.

Preiss has used the method in 192 operations, with additional narcosis in 23. In 64 cases morphine was given before operation (Aether-Rausch). The anæsthesia lasted from two and one-half to several hours.

I have made use of this anæsthesia in five cases of operations upon the stomach, in one case of carcinoma of the pancreas and three gall-bladder cases. My personal impressions in these few cases have been very favorable. I had one complete failure and one partial failure, in a case of resection of the

stomach, in which the anæsthesia did not last long enough and in which ether had to be administered for completion of the anastomosis and the abdominal sutures.

It is undoubtedly a very satisfactory method of anæsthesia in severe surgical conditions of the upper abdomen where we feel that a general anæsthesia would be better avoided. Personally I have not observed any ill effects from this mode of local anæsthesia and do not hesitate to recommend it in suitable cases. The technic is not any more difficult than that of a spinal anæsthesia.

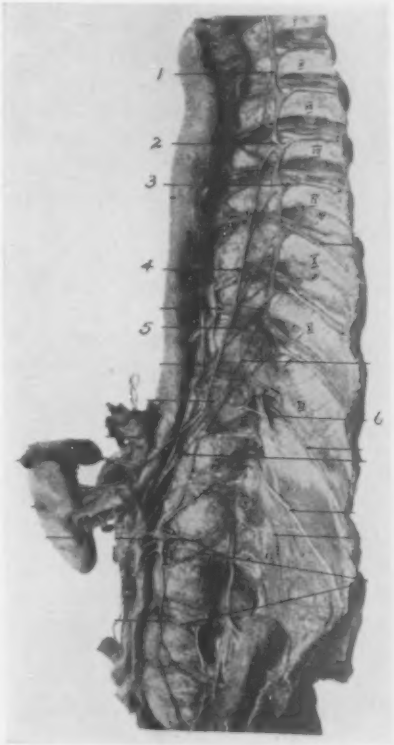

FIG. 3.—Sympathetic nerve and nervus splanchnicus major and minor of left side. 1. Sympathetic nerve (main trunk). 2. Sympathetic ganglion. 3. Communicating branch. 4. Splanchnicus major. 5. Splanchnicus minor. 6. Injection needle.

CASE REPORTS, SPLANCHNIC ANÆSTHESIA

CASE I.—E. Sch., age sixty-four. *Inoperable carcinoma of the stomach.* Splanchnic anæsthesia with 80 c.c. of 1 per cent. novocain adrenalin solution and 50 c.c. of ½ per cent. novocain adrenalin solution for infiltration of midline abdominal incision from ensiform cartilage to umbilicus.

Anæsthesia complete. No pain upon spreading apart of wound with large retractors. Stomach and neighboring organs can be handled freely without any pain sensation. Stomach can be pulled out of wound without pain. Large carcinomatous mass involving larger part of stomach along greater curvature with metastasis in omentum. Tumor considered inoperable. Closure of wound.

CASE II.—H. H., age sixty-five. *Carcinoma of stomach.* Splanchnic anæsthesia. Sixty c.c. of novocain adrenal solution, 1 per cent., and 25 c.c. of novocain adrenalin solution, ½ per cent., for anæsthesia of abdominal wall. On first insertion of needle into back some blood appeared, therefore withdrawal of needle. Another attempt succeeded without causing hemorrhage, but one has the sensation as though needle does not reach desired depth on account of its being too short (3½ inches, 9 cm.).

On opening abdominal cavity and exploring stomach very violent pain, parietal peritoneum very sensitive, no possibility of exploring of stomach as patient cries out with pain. Complete failure, probably on account of shortness of needle.

Therefore general ether anæsthesia was given. While he was being anæsthetized he suddenly went into collapse, withdrawal of ether and hasty closure of abdominal wound. Hasty exploration had demonstrated a large carcinomatous tumor at the pylorus, of the size of a large man's fist, which, however, was freely movable and probably could be removed.

Therefore one week later, another attempt at radical operation was made.

Splanchnic anæsthesia as before, but with a needle 12 cm. long. Same amount of anæsthesia was used. Anæsthesia very good. Exploration of upper abdomen perfectly

painless. Stomach can easily be pulled out through wound and with it the colon transversum. The tumor involving the stomach had also grown by extension into the mesocolon and into the wall of the colon transversum. A resection of the stomach, together with a large part of the colon transversum, was done. The operation was difficult and tedious. The patient gave the first signs of distress after the tumor had been removed (operation had then lasted one and one-half hours) when an attempt was made to pull the stump of the stomach forward to make the anastomosis with the jejunum. This pain, however, lasted only for the short time it was needed to place an addition-clamp. The anastomosis (Balfour-Polya) could be finished painlessly, the anæsthesia of the abdominal incision, however, had passed off (after two hours) so suture of the abdominal wall was painful. The patient had stood the extensive operation very well, had no signs of collapse, his pulse being about 90–100 during the whole operation. This was certainly a great success when one considers that at the previous attempt the patient promptly collapsed after the administration of a few c.c. of ether.

Although the patient had stood the operation itself very well, he began to show signs of exhaustion on the second day after operation and died the same night with signs of heart failure.

Case III.—S. J., age forty-five. *Large penetrating ulcer of the posterior wall of the stomach near the lesser curvature, floor of ulcer adherent to pancreas. Balfour-Polya resection of stomach.* Splanchnic anæsthesia. Eighty c.c. of 1 per cent. novocain adrenalin solution. Thirty c.c. for abdominal incision. Anæsthesia perfect for one and one-half hours, after this time it gradually wore off and patient had much pain and discomfort while placing clamps for gastrojejunal anastomosis.

It became necessary to give a few c.c. (140 c.c.) of ether to do anastomosis and to close the abdomen.

Case IV.—S. H. *Cholecystitis, pericholecystic abscess, sepsis. Death on table.* Patient in very poor condition. Was almost moribund when put on table. Splanchnic anæsthesia. Eighty c.c. of ½ per cent. novocain adrenalin solution, 140 c.c. of novocain adrenalin solution for incision of abdominal wall.

Gall-bladder, stomach, duodenum, omentum and colon tightly adherent to one another, opening of large peri-cholecystitic abscess. No evidence of pain during operation.

Sudden collapse on table and death. This death cannot be attributed to the method of anæsthesia, patient's condition was almost hopeless before she came to operation.

Case V.—M. R. *Exploratory laparotomy for a probable ulcer of the stomach.* Splanchnic anæsthesia. Seventy c.c. of ½ per cent. novocain adrenalin solution, 30 c.c. of ½ per cent. novocain adrenalin solution for abdominal anæsthesia. Complete failure. Thorough exploration of stomach cannot be done on account of severe pain and pressing of patient and the administration of a general anæsthesia became necessary.

Case VI.—R. F. *Cholelithiasis. Extirpation of gall-bladder. Cure.* Splanchnic anæsthesia. Thirty-five c.c. into area of twelfth dorsal vertebra, 15 c.c. into area of first lumbar dorsal vertebra, 60 c.c. for abdominal wall of 1 per cent. solution.

Anæsthesia was successful, although patient here and there showed evidence of a little pain. Patient was a little nervous and probably more frightened than anything else. Operation could be completed without general anæsthesia.

Case VII.—A. *Chronic jaundice. Carcinoma of pancreas.*

Case VIII.—H. P. *Resection of stomach. Balfour-Polya.* Death from bronchopneumonia.

Case IX.—C. K. *Cholecystectomy, for persistent biliary fistula.* Operation very difficult on account of previous cholecystotomy. Many very extensive adhesions between gall-bladder, stomach, duodenum; colon transversum had to be severed. Anæsthesia was perfect. Skin suture was a little painful.

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AN IMPROVED ABDOMINAL RETRACTOR

By Joseph L. DeCourcy, M.D.

of Cincinnati, Ohio.

The abdominal retractor herewith pictured has been used by members of the DeCourcy Clinic, for the past five years, and was not published before

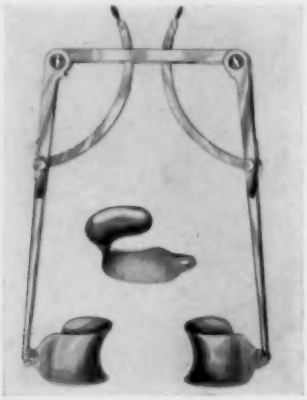

Fig. 1.—Abdominal retractor showing side view of blade.

it had proven itself satisfactory in every way. The special features which it typifies are as follows:

1. Because of its square base, it remains stationary upon the abdominal wall and does not move from side to side, as was our experience previously, with other retractors.

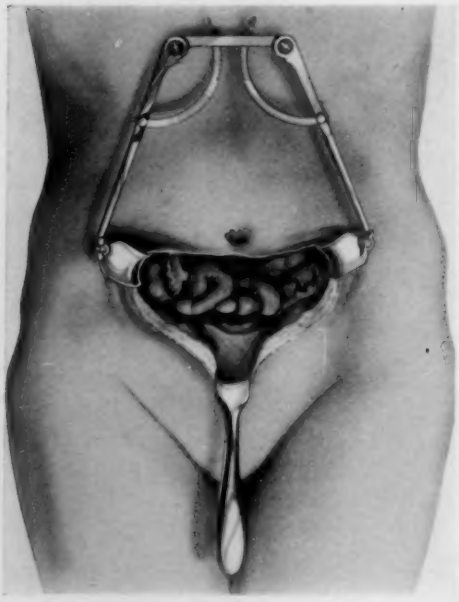

Fig. 2.—The retractor in position.

2. The blades adopt themselves to fat and thin abdominal walls, thereby preventing the necessity of changing blades.

3. The exposure obtained is at once adequate and uniform for all work upon the lower abdomen and pelvis.

4. After using on several cases, the handling becomes mechanical and is done subconsciously.

TRANSACTIONS
OF THE
NEW YORK SURGICAL SOCIETY

Stated Meeting Held November 28, 1923

The President, Dr. Eugene H. Pool, in the Chair

PANCREATIC CYST

Dr. Hermann Fischer presented a man, age forty-eight years, who was admitted to hospital August 30, 1923, suffering from pain and discomfort in upper abdomen. In July, 1923, he had first noticed a severe burning pain in the pit of the stomach, for which he was treated medically with some relief. He drank heavily at that time and very soon the pain returned with the same severity. It was now not confined to the epigastrium alone, but radiated into the left side to the back and towards the left shoulder. In the latter part of August he was taken with attacks of vomiting at short intervals. This attack lasted about thirty hours, during this period he was also troubled with violent hiccoughing. He was a man of very powerful physique who did not look very ill. Loss of weight insignificant. The abdomen was soft, without rigidity. Below the left costal arch, in the region of the left rectus muscle, there could be seen and felt a tumor of the size of a grapefruit. It is round and has a semi-fluctuating elastic feeling. It is not very painful and does not move on respiration. It seems to be situated below and somewhat in front of the stomach and above the transverse colon. It is not in connection with the spleen, which is not palpable and which percusses normally. Liver can be felt slightly below costal margin, and is smooth and not sensitive. Kidneys are not palpable. No other masses can be felt in abdomen.

Fluoroscopic with röntgenographic examination, reveals a marked defect involving the major part of the greater curvature of the stomach. This defect is not constant in the different positions. At the six-hour period the stomach is empty.

Stereoscopic röntgenograms after barium enema reveal a distinct pressure defect, involving the distal transverse colon and the splenic flexure. The film taken after defecation shows good colonic function with considerable stasis in cæcum and ascending colon. The above findings indicate a tumor mass causing pressure defect on the greater curvature of the stomach.

The diagnosis was: Large pancreatic cyst which has grown forward between the large curvature of the stomach and the transverse colon, behind the gastro-colic ligament.

Operation.—September 6, 1923. On opening the peritoneum a large cystic tumor of bluish color was found lying between the great curvature of the stomach and the transverse colon, covered by the gastro-colic ligament. The tumor seems to fill the whole bursa omentalis, reached toward the right as far as the hepatic-duodenal ligament, the foramen of Winslow was closed by the mass which also extended towards the left to the hylus of the spleen. It was so intimately adherent to the surrounding structures that extirpation was not considered practicable.

The gastro-colic ligament was divided between ligatures and the anterior surface of the cyst is exposed; the edges of the gastro-colic ligament were sewn, the parietal peritoneum thereby closing off the general cavity before the

cyst was opened. A large aspirating needle was pushed into the cyst and a clear amber-colored fluid withdrawn. Aspirating needle being withdrawn, the cyst was emptied as far as possible through a large trocar and canula. The anterior cyst wall was incised widely and the cyst wall sewed to the skin. The remainder of the wound was closed by layer sutures around the opening of the cyst. The interior of cyst was then packed with gauze.

The first five days after operation the secretion was rather profuse, but the cyst contracted very quickly and was healed out completely on the day of his discharge, twenty-five days after the operation.

Report of Examination of Fluid from Pancreatic Cyst.—Specific gravity, 1.021; color, golden-yellow (viscid); protein, 3.1 per cent.; reaction, neutral; bile, negative; blood, positive; leucine, negative; tyrosine, negative.

Ferments.—Amylase, very active; lipase, negative; protease, negative.

Microscopic.—Many red cells, numerous leucocytes and debris.

FIBROMA OF STOMACH

Dr. Hermann Fischer presented a man, age forty-eight years, who was admitted September 2, 1923. His chief complaint was pain in the left hypochondrium, at first sharp in character, radiating to the precordium with no relationship to taking of food. Vomiting two to three hours after eating, vomitus being coffee-ground colored and foul tasting. He had noticed these symptoms the first time two months before entering the hospital. Patient has not been jaundiced. He is fairly well nourished. No previous illness. Has lost fifteen pounds in two months. Appetite is poor. No urinary symptoms. No gonorrhœa or lues. Family history negative. No masses can be felt in the abdomen. There is considerable muscular spasm and tenderness in the upper segment of the left rectus muscle. Right axillary and inguinal glands enlarged.

Stomach Contents.—P. C., color red-brown. Moderate amount of mucus, fluid with sediment, which is fairly well digested. Free HCl, 50. Total 64. Blood (guaiac. test) positive. Microscopic: Starch granules, few red blood-cells.

X-ray Examination.—The röntgenograms reveal a constant defect involving both curvatures of the stomach in prepyloric area. The stomach empties normally within the six-hour period. The above findings indicate carcinoma of the prepyloric region.

Stool.—(Guaiac test); blood strongly positive, upon repeated examinations after meat-free diet.

Blood.—Hæmoglobin, 65 per cent.; red blood-cells, 3,690,000; white blood-cells, 5200.

Operation.—October 11, 1923. The stomach was easily delivered and on palpation a hard nodular tumor was found situated on the posterior wall near the lesser curvature. A resection of almost two-thirds of the stomach was done after Billroth I. A duodenal tube was inserted into the duodenum so that feedings could take place immediately after operation. Patient made an uneventful recovery and was discharged from the hospital two weeks after the operation. He now feels perfectly well and can eat most foods.

Pathological Examination.—Diagnosis, submucous fibroma of the stomach. Specimen consist of a large piece of stomach 14 cm. long and 13 cm. wide, varying from 1 to 2 cm. in thickness. At one spot a round circumscribed growth is seen which measures 2 cm. by 2 cm. by 1.8 cm. Surrounding this growth there is an inflammation area, dark red in color, 4 cm. by 7 cm. This area is slightly thickened and at one point a small, hardened nodule is found.

Microscopical Examination.—Section of the stomach tumor shows a circumscribed fibrous nodule which involves the mucosa and submucosa. A part of the surface is covered with atrophic mucous membrane, though the central part is bare of the epithelial covering and shows superficial ulceration. At the edges of the tumor the gastric mucosa is hypertrophic.

ARTHROPLASTY FOR ANKYLOSIS OF ELBOW

DR. JAMES N. WORCESTER presented a man, twenty-five years of age, who was admitted to Reconstruction Hospital, May 9, 1922. In June of 1918, he received a gunshot wound of right elbow. Had several operations in France and in the United States for removal of sequestra and infection. Wound finally healed in August, 1921.

His elbow is now ankylosed at an angle of 90 degrees. No pronation or supination present. Considerable scar-tissue about elbow. X-ray showed complete fusion of humerus with both radius and ulna and fusion of head of radius with ulna. For a few days after his admission he was given intensive physiotherapy, in an attempt to stir up any latent infection. Nine months have now elapsed since complete healing of his wound.

Operation.—May 22, 1922. Arthroplasty right elbow, McAusland. Horseshoe incision over the dorsal surface elbow, passing from one condyle to the other. A short linear incision was then made, beginning at the centre of the horseshoe incision and extending upward over the humerus for one inch. The soft tissues retracted over the olecranon process and with saw the olecranon with the tricipital attachment was divided, and then with chisel and hammer separated from the shaft of the ulna. The head of the radius, being fused with capitellum, required separate division. The olecranon process, fused to the coronoid fossa, was then separated with chisel and turned upwards. The condyles were then reshaped, as was also the articular surface of the coronoid notch, the old one being considerably deepened into the cancellous bone. The head of the radius was somewhat shortened so that it would not prevent extension. All surfaces then smoothed off with file. A strip of fascia lata secured from the left thigh, was then sutured over the end of the humerus with several No. 2 interrupted chromic gut. The olecranon process was shortened so that part of the tricipital attachment extended over the end of the olecranon. The remains of the olecranon process were then sutured to the ulna with two heavy, kangaroo tendon sutures. Capsule closed with No. 2 chromic gut. The ulnar nerve which had been freed and lifted aside was then replaced subcutaneously, skin closed with silkworm gut and silk and arm immobilized with plaster splints. Thigh wound closed with silkworm and silk.

Following operation a hæmatoma developed which was evacuated through angle of wound. A mild infection followed. Two months later a small sequestra was removed and three months later another one. After this the sinus healed completely.

Immediately following the operation the arm was kept in a posterior moulded splint with elbow at right angles. Motion was started about the tenth day. The progress in this case was very slow, due presumably to the fact that immediate mobilization was not instituted after the operation. Five months after operation he had only 60 degrees range of motion. So under anæsthesia the elbow was stretched and motion encouraged. By persistant exercise this was increased to 120 degrees in the next six months.

Now he has an excellent result with almost complete flexion and extension. He is working as an electrician and while he still lacks power to lift heavy

weights, he says that his arm is very much more useful than before operation. He has no pronation or supination.

DOCTOR WORCESTER then presented a second patient, a man twenty-two years of age, who was admitted to Reconstruction Hospital, April 24, 1923, with an ankylosed left elbow. This elbow was fractured eleven years ago. Was operated on at Lebanon Hospital. Since that time elbow has been stiff. The elbow is ankylosed at 90 degrees angle. Pronation and supination very slightly limited. Skin and soft parts in good condition. Considerable bony thickening, especially in antecubital fossa. X-rays show absence of external condyle removed at previous operation. There is union between the humerus and ulna. Head of radius intact.

Operation.—May 2, 1923. Typical McAusland. Transverse posterior incision. Ulnar nerve retracted. Olecranon cut across with saw. Union of ulna and humerus cut across with chisel. Internal condyle of humerus removed. Coronoid fossa of ulna hollowed out, care being taken not to disturb head of radius or radio ulnar articulation. Lower end of humerus smoothed off and made to fit the head of radius and hollowed out ulna. A strip of fascia lata was taken and entirely freed of fat. This was placed over end of humerus and sutured anteriorly to anterior capsule of joint, as high up on anterior surface of humerus as possible. It was then tacked down posteriorly and laterally with interrupted chromic sutures. The divided olecranon process was united with two kangaroo tendon sutures and the lateral expansion of the triceps utilized to form the lateral portions of the new capsule, using chromic gut. Skin closed with silkworm and silk.

The arm was suspended with elbow at right angles and motion insisted on from start. Following operation there was considerable oozing and on the third day the wound was opened at one angle and a large hæmatoma evacuated. There ensued an infection of very mild degree which gradually cleared up. A sinus persisted until August 15, when it entirely healed. One month later a small fluctuating area appeared, and this was opened and several small sequestra appeared. Since then the sinus has closed and opened several times and it is evident now that other small sequestra are present, and if these do not extrude themselves very shortly they will be removed.

In spite of the infection the result is excellent. He has a complete range of motion. Pronation and supination are present and normal. His elbow is stable and he has good power and can lift a considerable weight.

DOCTOR WORCESTER, in reply to questions, said that as to the fate of the fascia he did not know what happened to it. In the first case he was sure that most of the fascia had come out. It had been a distinctly subacute infection with no bacteria and did not heal up until a lot of sloughs, which he thought were composed of fascia, came out. He believed that the fascia was responsible for the hæmatoma and long non-healing. He would be tempted in his next case not to use fascia but to make a joint-surface to fit well and then start with immediate motion. As far as lack of stability he had not seen an arthroplasty without instability. It does not bother the patients very much if they can perform the finer motions.

CARCINOMA OF TONGUE

DR. FRANK S. MATHEWS presented a woman, who first came to him nine years ago; she is aged thirty-five, with a history of having had a lump of small size appear on the side of the tongue three months previously. It

had been locally excised. When first seen nothing was demonstrable but the scar on the lateral margin of the tongue. Original sections of the growth were examined and pronounced epithelioma. In February, 1915, a portion of the tongue was excised, including the scar, not going very wide of the scar on the dorsum of the tongue, but rather extensively excising the tissues in the floor of the mouth. At the same operation the glands down to the level of the larynx were removed through an incision under the chin. Patient has had no sign of recurrence and is in good health. Between the original local excision and Doctor Mathews' operation, patient was given one radium treatment by means of a radium tube placed in contact with the scar in the mouth. The tissue removed showed carcinoma in the scar. Radium effects were said to be recognizable microscopically. He called attention to the length of time that she has remained cured, and the fact that the usual etiological factors such as sex, bad teeth, tobacco habit, and leucoplakia, were all absent.

TUBERCULOSIS OF BREAST

DR. FRANK S. MATHEWS presented a woman, forty-three years of age, who gave the following history:

Two years previous to operation on the patient, she had brought in her child, aged nine months, who presented a small tumor over the parietal bone and a sinus at the ankle. The child was conspicuously healthy in appearance. The swelling over the parietal bone proved to be a cold abscess under the periosteum. Sections of the abscess wall and curettings from the ankle showed tuberculosis. The child had been brought up on the mother's breast milk.

Six months ago, the mother presented herself with a somewhat tender mass in the right breast, which seemed about the size of a hen's egg. The mass was fairly discrete, slightly tender, no nodes felt, nipple not retracted nor skin adherent. The tumor was rather large and lacked the usual characteristic symptoms of a carcinoma. After watching the tumor for three weeks without noting any change, it was operated upon and on incision of the tumor, the impression given was that he was dealing with a carcinoma. A thick fluid, however, could be expressed from several portions of the mass. The usual operation for carcinoma of breast was undertaken, breast, auxiliary contents and muscle being removed. The pathologist's frozen section report was that there was no evidence of carcinoma. The final report was "granuloma of breast, probably tuberculosis of breast and axillary nodes." The impression was that the breast contained a small old tuberculous lesion to which a more recent acute inflammation had been added. The reason the pathologist did not make a positive diagnosis of tuberculosis was that no tubercle bacilli were identified in the sections. This would seem to be a case of primary tuberculosis of the breast, not secondary to gland or rib tuberculosis, in a patient who seemed otherwise quite well and who had no present or past history of lung involvement. The suspicion would be that the nursling's tuberculosis was derived from the mother's breast.

DR. HUGH AUCHINCLOSS said that although cases of tuberculosis of the breast were not apparently so very uncommon, the source of the infection and its pathogenesis were still somewhat obscure. He cited three cases as having a bearing on the source of the infection. The first had already had multiple tuberculous foci the neck, axillæ and chest wall, all either operated on or discharging spontaneously. All had healed save one in the left axilla, which had been discharging four years. Beneath the outer half of the

areola of the breast on the same side was a proven tuberculous abscess that when dissected out was found to be connected with the mass of tuberculous glands at the bottom of the axillary sinus. Most of the breast was saved in this case and the block dissection of the abscess, glands, axillary sinus and tissue intravening, resulted in a prompt clinical cure. The second case had had a discharging sinus just inside the areola of the right breast for almost a year. On excision of the abscess a sinus was found to extend to the sixth interspace close to the sternum where the cartilages are partially fused, and found to lead through the interspace into the anterior mediastinum where existed a small abscess, probably a broken-down lymph-gland along the internal mammary vessels. The third case was one of Doctor Dowd's at the General Memorial Hospital, some years ago. She had had tuberculous cervical glands removed previously. Both axillæ contained enlarged lymph-nodes at the time of operation for carcinoma of the right breast, outer hemisphere. Doctor Dowd removed the breast lesion first and subsequently did a radical mastectomy. Doctor Auchincloss found not only a very typical carcinoma of the breast in frozen section at the time, but, after making many subsequent sections of the axillary nodes, that no carcinoma cells could be found and they were simply riddled with discreet and conglomerate tubercles throughout. Some time later Dr. W. G. MacCallum happened to be looking at some large sections of the carcinoma from the breast and pointed out what appeared to be three tubercles actually in the margin of the carcinoma. He called attention to the fact that Doctor Mathews' case was associated with tuberculous axillary nodes, and it was Doctor Auchincloss' opinion that so-called primary tuberculosis of the breast probably does not occur at all, but that the disease enters the breast tissue by retrograde metastatic routes from tuberculous lymphatic tissue, the distributing point of which is often difficult to find, and that blood stream infection is difficult to prove and is probably very unusual. He considered the whole subject of the source of tuberculosis of the breast of great interest inasmuch as its routes of travel are the same as those taken by cancer cells, for both diseases, as is well known, diffuse so preëminently by the lymphatic routes.

Dr. W. S. Schley said that breast tuberculosis is a rare disease, as compared with the malignant and benign growths, particularly the primary cases. A search of the available literature of the world showed but 120 cases up to 1910; scarcely more than twelve of these were undoubtedly primary in the breast, the rest being secondary to a tubercular process elsewhere. Bull, in 1894, analyzing 186 breast cases of his own, found but one case of tuberculosis. The history of mammary gland tuberculosis began in 1829 with Sir Astley Cooper's work on *Diseases of the Breast*. It was not until 1860 that the first case was proven microscopically, and not until 1881 that a case was proven bacteriologically, the present generally accepted method. The literature upon the subject is also scant compared with that upon other diseases of the breast. A few cases are added from time to time. The

disease occurs more often in breasts that have been functionally active, but eight male cases were reported up to 1910. The oldest patient was seventy-three years of age, the youngest one year. The method of infection is still unknown but it is probably through the blood stream, at least in the primary cases. Direct extension through contiguity occurs not infrequently; from a carious rib, from the periosteum or from the pleura, tubercular axillary glands have apparently produced a retrograde infection, although it is difficult with involvement of the breast simultaneously to say which occurred first, as a small focus of disease in the breast may produce enlarged and suppurating glands in the axilla. Doctor Schley said that his own case of primary breast tuberculosis, reported in 1903, had no involved axillary lymphatics and a tuberculin test made later gave a negative result. In the primary cases, the apparent good health of the patient has been frequently noted in the literature, and this was true in the speaker's case and appeared true in Doctor Mathews' case. There are various forms of the disease, single nodular, multiple nodular, confluent, and disseminated; all tend toward breaking down and abscess formation with the consequent development of fistulæ and sinuses. Few are diagnosed before operation. The best treatment is amputation with the clearing out of the axilla. The primary cases have a good prognosis; the secondary cases depend upon the degree and extent of the tubercular process elsewhere.

TRAUMATIC STRICTURE OF SMALL INTESTINE

Dr. Frank S. Mathews presented a child, aged four and one-half years, who was injured by an automobile four months ago, sustaining abdominal and head injuries. Recently the child has had attacks of pain with visible peristalsis and much distended intestinal coils. X-ray following bismuth meal showed fairly prompt elimination; distended coils of gut were always visible. Bismuth injection showed that the obstruction was not located in the large intestine. Operation revealed a stricture in the middle of the small intestine, with enormously dilated and thickened intestinal wall above the point of constriction. The intestine seemed to angulate at this point and was also covered with adhesions. A resection was done, ends closed, and side-to-side anastomosis made. Microscopic examination showed a distinct defect in the muscular wall of the gut which was replaced by fibrous tissue. The injury then would seem to have been one which divided the thickness of the muscular coat without perforating the mucous membrane. In the healing process, this narrowed the lumen and also caused angulation. The child developed a fecal fistula post-operatively.

RESECTION OF A SEGMENT OF THE CHEST WALL FOR CARCINOMA

Dr. George H. Semken presented a woman, now aged fifty-seven years, who came under observation in September, 1918, because of a large carcinoma of the left breast, 7.0 cm. in diameter, situated in the outer half between the radii 1.30 and 6.00 o'clock. The tumor was rounded, and of stony hard consistency. The nipple was not retracted; there was no fixation to the skin

or change in its color and the tumor seemed movable upon the deeper structures. The axillary lymph-nodes were large, and there were also palpable, enlarged nodes in the supraclavicular space. Physical examination otherwise was negative.

The duration of the tumor was about one and one-half years, and there had never been any subjective symptoms. The diagnosis of carcinoma had not been made by her medical attendant, and she had therefore, had no treatment during the entire period excepting some internal medication. The family history was negative for cancer. She had been married for nineteen years, but had never been pregnant. Menstruation still continued normally. There had never been any known inflammatory process in the breast, and the only possible etiologic factor that could be discovered, was a trauma through the impact of a baseball upon the breast.

On September 13, 1918, the combined radical breast and neck operation was performed. Colonic ether anæsthesia was effective and well borne. The breast operation followed the technic of Willy Meyer, with the additional epigastric dissection suggested by Handley. The breast and its overlying skin were removed, together with the pectoral muscles, axillary fat and lymphatics, the anterior and inner parts of the sheath of the axillary vein, the subscapular fat and lymphatics, the fascia over the serratus, and the epigastric fat with parts of the upper, anterior rectus sheath of both sides. Closure was effected with suture and a small primary Thiersch graft. The neck dissection was done *via* the incision of DeQuervain, running along the sternocleidomastoid line from the middle of the neck downward, and then curving back at and along the clavicle to the edge of the trapezius. The triangular flap of skin and subcutaneous fat was reflected; the sheath of the sternocleidomastoid muscle was incised, as was also the insertion of the outer layer of the middle cervical fascia along the clavicle; the sternocleidomastoid muscle was drawn forward, and the sheath of the internal jugular vein was incised, first on its anterior surface, and then, after liberation from the vein, along its posterior surface also. With this preparation, it was possible to extirpate the supraclavicular lymphatics radically, within the two layers of the middle cervical fascia. The superficial cutaneous nerves, the external jugular vein, and the omohyoid muscle had to be divided. Wound closure was done with sutures, split rubber tube drainage being provided through a small stab wound in the posterior line. Recovery was uneventful, and the patient was able to leave the hospital, with the wounds wholly healed, fifteen days later. The microscopic examination of the excised tissue showed a schirrus carcinoma in the breast and carcinoma in the axillary nodes. Carcinoma was not found in the cervical nodes, but since no extended search was made, and the node involvement was unusually extensive for a case presenting no ulceration, the case was regarded as an early cervical node cancer involvement also.

The patient remained well for one year; then several small nodules were noted in the skin and subcutaneous tissue above and below the site of the Thiersch graft. On September 16, 1919, an area of skin 15 cm. by 9 cm. in size, containing the Thiersch graft and all the discoverable nodules, was removed, and with it, the underlying subcutaneous fat and the fascia over the intercostal muscles. Closure was effected by making a new incision parallel to the lower wound margin and well below it in the upper abdominal region, undermining the flap so outlined but leaving it attached at each end, and sliding this up in bow fashion, to cover the chest wound. The resultant defect at the flap site was covered with Thiersch grafts, after the area had

been narrowed by drawing in and "tacking down" the lowest margin with sutures. Recovery again was prompt and uneventful.

The second recurrence was noted on March 7, 1921, as a nodule with slight erosion just above the upper line of the flap from the second operation, and behind the vertical scar line from the first operation. Under this nodule was a tumor extension down to the rib and intercostal muscles, extending above and below the transverse scar line. The third operation was done on March 19, 1921. Under the colonic ether anæsthesia of Gwathmey, which was very well borne, a segment of the chest wall consisting of parts of the fourth, fifth, sixth, and seventh ribs, and containing the new growth with a wide area of healthy skin, the intercostal muscles, and the parietal pleura under the central half of the segment, was excised. The opening of the chest cavity caused no respiratory embarrassment, and the pulse rate, which had been 72, rose to 84, to return again to 72 after a few minutes. The lung did not wholly collapse. Closure of the wound was effected by means of a sliding flap from below, with a single pedicle posteriorly, made by again cutting the lower margin of the flap made at the previous operation, and also incising it anteriorly, then liberating it from the underlying tissues and sliding it upward into the gap. The wound surface thus left on the lower chest wall was covered with Thiersch grafts. No drainage was employed. Convalescence was uneventful; there was no cough; and no fluid was noted in the pleural cavity. Healing was by first intention, and the patient left the hospital nineteen days after the operation.

In October, 1921, some small subcutaneous nodules appeared at the upper scar line of the flap; and while none was excised for diagnosis, it was deemed advisable to treat these with the X-ray. This was done under the supervision of Dr. Francis C. Wood; and the nodules have disappeared. The patient is now apparently well and has no discomfort of any kind. The bony defect in the chest wall is visible only when she coughs or makes other forcible chest movements. She has full function also, in the arm.

Dr. Nathan W. Green expressed his belief that this case was a signally successful one and should not go undiscussed. The fact that the patient was alive and apparently cancer free at the end of five years in itself was worthy of attention. What Doctor Semken had done had been attempted by other physio-therapists by repeated attempts at destruction or controlling of cancer cells, or at increasing the resistance of the organism to invasion by the use of radium or by deep radiotherapy. This was still *sub judice*. But to date the best proven therapy was thorough and early surgery. An interesting point about this case was, that while Doctor Semken resected the chest wall and opened the pleura widely, there was no apparent shock nor any disturbance of the pulse or respiration. This could not always be looked for. At a meeting of a group of men, especially interested in thoracic surgery two years ago in Boston, it was held by a large part of the members present that some means for artificial respiration should be ready at hand in all cases when the free pleura was to be widely opened. He had no doubt that Doctor Semken took the precaution to have at hand some simple apparatus for inducing artificial respiration in this case.

Dr. W. S. Schley said that the case suggested two facts: first, that one need not always be discouraged in the face of recurrence, and second, that

carcinoma is sometimes an erratic disease. A local recurrence, or one in the supraclavicular glands, may be the only extension of the disease, and after careful examination it is often justifiable and proper to operate on these cases, as they sometimes wait for years without further evidence of the disease and die of other affections. Carcinoma of the breast in some cases appears to remain a local disease for long periods, contrary to its usual custom. A case of Doctor Schley's recurred and was operated on by him thirteen years after the primary operation. The recurrence was a single flat nodule in the lower end of the scar; there were no demonstrable metastases elsewhere. A second recurrence in the scar was also a second case, seen two or three years ago, and had been operated on twenty-six years before. She presented multiple nodules about and in the cicatrix on the chest as though operation had been done a year or two previously. There were no other demonstrable involvements at that time, although no X-ray of bones was made. This patient appeared to die of inanition without definite involvement of any organ, but general infection must have occurred. Another case recurred at the end of nine years in the supraclavicular glands and, after operation, remained well for over a year until lost sight of. Doctor Schley said that he had operated on a case similar to that of Doctor Semken, removing parts of two or more ribs for persisting local recurrences. The disease finally invaded the lung, which had become attached to the chest wall and, on the last operation, some of the lung was removed. She had had a number of X-ray treatments. This patient's disease apparently never metastasized widely but remained a local affair. She lived eight years after operation, but had been lost sight of the last year or so, although Doctor Schley had heard she lived a total of twelve years.

Doctor Semken, in closing the discussion, said that the suggestion of Doctor Green, that the opening of the chest cavity might at times give rise to severe respiratory embarrassment, was timely. In this instance, the Meltzer-Auer apparatus had been in readiness for immediate use if required. In another similar case of resection of part of the chest wall for localized, recurrent cancer, the wide opening of the pleura caused no respiratory disturbance whatever; while in a recent case of intrathoracic, extrapleural neurofibroma, at the costo-vertebral angle, the accidental tearing of the pleura over about one inch, caused considerable difficulty in breathing and cyanosis. This patient was lying on his side, while the other two were lying supine; but this probably does not explain the difference in the respiratory reaction.

The question of the possibility of cure in cases of cancer of the breast with both axillary and supraclavicular lymph-node involvement was denied by Cheyne, but has been proved by the successful cases published by Halsted. Cheyne believes that involvement of the nodes along the subclavian vein meant involvement along the innominate also; but the lymphatic tract of this region ends in the subclavian lymph trunk, which enters either the right lymphatic or the thoracic duct in the lower neck; and this field seems to follow the

experience of cancer localization shown in other node groups. The weak spot surgically is the region under the clavicle; and the best procedure would therefore seem to be the combined neck and chest operation in one stage, so that the junction of the two operation fields, under the clavicle, can be clearly determined. It is a desirable procedure, in all radical breast operations, to mark the axillary tissue during its removal, with black silk marking threads, one thread marking the tissue from the highest point reached on the axillary vein, and two threads marking the region about the subscapular vessels (the lowest point on the axillary vein). If the laboratory report upon the tissue shows carcinoma in the nodes at or near the highest point of the dissection, a cancer involvement of the supraclavicular nodes may be presumed, and the neck dissection should follow without needless delay.

CICATRIX-DEFORMITY OF DORSUM OF HAND AND FINGERS

Doctor Semken presented a man, now aged twenty-six years, who was injured in the bomb-explosion in Wall Street, in 1920, and among his injuries, sustained severe burns to the dorsum of both hands, the left being the more severely injured. The resultant cicatrices become keloidal almost immediately after the healing was completed, and he then received treatment with radium and the X-ray from November, 1920, to February, 1922. When he came under observation on September 7, 1922, the condition of his left hand (which is the subject of the present report) was as follows: The skin of the whole dorsum of the hand, the dorsum of the base of the thumb and fifth finger, and the whole dorsum of the second, third, and fourth fingers was thin and cicatricial. The burn destruction had evidently not gone below the skin, but, in consequence of the radiation treatment, there was marked atrophy of the skin, with telangiectasis, and occasional crust formation over superficial radium ulcers, especially on the fingers. There was rigidity in the finger covering; and contractures had developed at the site of the webbing between the fingers.

The procedure in this case was the excision of the cicatrized skin, and its replacement with a flap from the lower, lateral chest wall. On November 28, 1922, under general anæsthesia and with Esmarch ischæmia, the skin and subcutaneous tissue of the dorsum of the left hand was removed, from the wrist down the hand, the line of section ending at the base of the thumb, the distal end of the second phalanges of the index, middle, and ring fingers, and the middle of the second phalanx of the fifth finger. All the fine spider-web cicatricial strands over the tendon sheaths were removed. The Esmarch bandage was then removed, and ligature hæmostasis was completed. The wound was temporarily covered with gauze moistened with saline solution. Then, a suitably shaped, relatively quadrilateral flap of skin and subcutaneous tissue was prepared on the lower right lateral chest wall, where (1) the skin and fat were thinnest, and (2) where the left hand could be placed without discomfort to the patient. This flap was elevated from above down, leaving the pedicle along the lower border; and the resultant defect was immediately closed, partly by drawing in the edges and suturing these (with the assistance of small supplemental relaxing incisions), and by covering the remainder of the wound with broad Thiersch grafts, which were made to cover the raw surface of the pedicle also. A small sterile dressing was applied over this area, firmly fixed with numerous sterile adhesive plaster strips to guard against displacing the grafts; the left hand was then placed over this, with

the palm flat against the dressing; and the flap was placed *in situ* and sutured upon the dorsum of the hand, the pedicle coming into relation with the ulnar margin of the hand. Thus the flap covered the dorsum of the hand in a broad, blanket-like manner, giving it the appearance of a duck's webbed foot; for separation of the finger flaps at this time would have cut off the nutrition of those parts. The fingers were separated widely with gauze pads, to allow for the maximum of new finger skin in the bridges between the fingers; and small Thiersch grafts were placed upon the raw flap surfaces between the fingers, to favor early healing. Gauze pads were interposed between the arm and the chest to prevent dermatitis from skin contact; and fixation of the arm was effected with a plaster-of-Paris case. The sutures were removed eight and ten days later, through a window cut in the case. The case was removed and the pedicle was divided, seventeen days after the operation; and four days later, under local anæsthesia, the ulnar border of the flap (previously the pedicle), was prepared and sutured to the ulnar margin of the palm, and the stump of the pedicle was reimplanted in the chest wall. Healing had been complete except at a small part of the angle at the base of the thumb; and this soon healed by granulation.

On January 9, 1923, six weeks after the operation, the fingers were separated by cutting the web of flap tissue between them, removing the excess fat at the edges, and sewing these to newly cut wound margins on the normal finger skin. At this time also, the excess of subcutaneous fat in the flap tissue of the fingers was excised from the section over the first phalanx of the index, middle, and ring fingers; and a revision scar-excision and suture was done at the base of the thumb; but no attempt was made then, to restore the normal finger-webbing.

The final procedure was carried out September 21, 1923. The excess of subcutaneous fat under the tips of the finger-flap tissue (over the second phalanges) was excised, and the thin skin flaps were again sutured in place; and the webs between the fingers were restored by Agnew's technic. This consisted in cutting a triangular flap in the tissue of the dorsum, over the site of the web, with its apex distal and its base at the knuckles. This flap was then raised, the remaining tissue between the fingers was incised well up into interdigital angle, and the excess of fat in this part was removed. Finally, the triangular flap was drawn down between the fingers, its apex meeting the palm, and it was sewed in place with fine silk. The lateral finger wounds could also be closed with sutures, although usually, it has been necessary to close these with small Thiersch grafts. The final result is satisfactory. He has a normal skin and fat covering for the hand and fingers, capable of being stretched and of withstanding the cold; and sensation has returned to a considerable degree. A similar procedure will be carried out with the right hand in the near future.

RHINOPLASTY FOR EXTENSIVE EPITHELIOMA OF NOSE

Dr. George H. Semken presented a man, now aged sixty-eight years, who noted a small lesion on the left ala of the nose about eight years ago. It received no treatment for a few years, owing to the patient's negligence, but its progress was slow. His subsequent history was the usual story of incomplete surgery, a number of X-ray "cures," and then a combination of these, until in June, 1923, when he came under observation, he had an advanced cancer of the nose involving the lower two-thirds of the right side, the adjacent portion of the left side at the midline, the upper septum, the

floor of the right nostril, and the adjacent part of the right cheek. The ala had been completely destroyed.

On June 14, 1923, under colonic ether anæsthesia, the cancerous tissue and a wide margin of healthy tissue were excised. This involved the removal of the major part of the right side of the nose, including the corresponding part of the right nasal bone, about one-fourth of the mesial part of the left side of the nose, the upper third of the septum, the floor of the right nostril, and a part of the right cheek. As a preliminary step, the surface of the lesion had been cauterized with a Pacquelin cautery to prevent implantation of cancer tissue during the operation. The large defect thus produced was covered with a pedicled flap from the right half of the forehead, suitably shaped, its pedicle being at the nasofrontal region. The raw surface of the flap within the nostril space was covered with a Thiersch graft, as was also the defect in the nasal floor. The defect on the forehead was similarly covered with a broad Thiersch graft, the wound edges being left uncovered, (1) to prevent elevation of the graft by later bleeding from these edges, and (2) to favor a better cosmetic result through the drawing down and flattening of the skin margin by contraction of the edge scar-tissue. A ring of iodoform gauze was laid around the graft to cover the raw edges of the forehead wound. Prompt healing followed, and two weeks later, on June 28, the pedicle was divided, the upper flap edge was sutured in place, and the pedicle stump was returned to its original forehead position, after excision of the necessary amount of the recently placed Thiersch graft at that site.

This brought the case into the usual completed stage of unilateral rhinoplasty for cancer; but two problems remained for solution, (1) the need to keep the new ala well shaped, and (2) the need to prevent nasal stenosis through contraction under the Thiersch grafts, and through shortening and broadening of the new ala. As a first step in meeting these indications, it was necessary to replace the lost alar cartilage with another, and this was obtained from the concha of the right ear. On July 12, 1923, under local anæsthesia, an incision about one-half inch in length was made at the outer end of the alar portion of the nasal flap. From this wound, a sharp-pointed knife was made to cut a subcutaneous tunnel in the flap, to the nasal tip, as a site for the cartilage implant. Bleeding was checked by manual pressure over gauze pads, so that no clots could form in the wound. A curved incision was next made on the posterior surface of the ear, just distal to the sulcus at the mastoid junction. The skin was reflected on both sides of the incision, and the cartilage was freely exposed. A triangle of cartilage with perichondrium on the posterior surface was removed from the bowl-shaped concha, its base being at the outer end and its apex toward the auditory canal; and the incision in the skin of the ear was closed with silk sutures. The cartilage thus obtained was then inserted into the subcutaneous tunnel in the alar part of the flap, through the marginal nasal wound, compression was exerted for a few minutes, for hæmostasis, and the small nasal wound was closed with sutures. This implant healed without visible reaction, and an interval of a few months was allowed to elapse before the second procedure was carried out.

As had been expected, contraction occurred in this time, the ala had taken on a bulbous appearance, and the right nostril was merely a small slit. To overcome this condition, two small procedures were necessary; and these were carried out, under local anæsthesia, on October 2, 1923. First, a quadrilateral flap of skin with a minimum of fat was cut from the broad alar edge, its base at the floor of the nose; and second, an incision was made in the remaining alar margin, along the thickened edge, the skin margins

were raised, and the excess of fat was removed, making the ala as thin as was deemed safe. Then the deeper part of the flap attachment to the floor of the nose was incised, to open the nostril freely, and the quadrilateral skin flap was laid down upon this raw floor-surface, to which it was held in apposition by a firm gauze packing. Finally, the margins of the alar edge incision was sutured, and only a small wound remained at the outer edge of the ala, for healing by granulation (it being expected that the skin would be drawn around by the contraction). Gauze-wrapped rubber tubing was used in the beginning to keep the nostril well opened, and this was later replaced with a shortened Kernon nasal splint of hard rubber. The final result is a presentable nose, with firm ala and an open nostril. The forehead graft is not conspicuous, and there is no visible deformity in the ear.

MARGINAL JEJUNAL ULCER

Dr. John F. Erdmann presented a man upon whom Doctor Schley had done a gastro-enterostomy eleven years ago. For a period of six years thereafter he felt perfectly well, gaining in weight, etc. For the past five years he has been complaining of very much the same type of symptoms he did before operation, with an increased manifestation of pain and increased symptoms, practically unbearable during the past three months. He presented a picture of marked anæmia, stooping posture, inability to walk and suffering agony. There had been some vomiting. He recently had been X-rayed with negative findings. His pain extended downwards to the left; and he had pain on pressure immediately to the left of the median line of the epigastrium. The man was kept two days on Murphy drip and then operated upon with the following findings: A large ulcer, fully an inch in diameter, between the stomach and the jejunum which was perforated at the proximal loop of the jejunum. The transverse colon was densely bound down to this ulcer at the margin of the former anastomosis, an obstruction at the pylorus due to an old ulcer. A complete revision of his gastro-enterostomy was done by closing the stoma in the stomach, doing an end-to-end anastomosis in the jejunum separating the colon from the margin of the gastro-enterostomy, removing his gall-bladder and appendix, and doing a Horsley at the pyloric end. He has gained thirty pounds.

Dr. W. S. Schley said that he had operated on the patient in 1912, at which time there was an enormous infiltration of the pyloric area and very general adhesions about this end of the stomach, probably benign, so that nothing else could be done but a gastro-enterostomy, after which he was well for nearly six years. He had written this fall that he was ill again and arrangements were made for him to go to the hospital, but he got frightened and left before operation. Doctor Schley had not known what became of him after that until to-night. It was interesting to note that a long tracing of stomach operative work was necessary if one were to arrive at definite knowledge of the value of one's operative procedures. Some ulcer cases would do badly regardless of the operative procedure and care in technic.

SEQUELÆ OF EPIPHYSEAL LINE INJURY

Dr. Morris K. Smith presented two cases with the following histories:

Case I.—T. B., suffered an epiphyseal separation of the lower end of the radius four years ago, when seventeen years of age. The displacement was reduced under anæsthesia. The immediate result was good. Eight months

later he returned complaining of weakness of the wrist and prominence of the end of the ulna. At this time ossification was largely completed in the injured epiphyseal line. At the end of a year it was complete. At present there is shortening of the radius of three-quarters of an inch. The function is good, but a permanent deformity remains.

CASE II.—E. M., at the age of thirteen, suffered a vertical fracture through the lower epiphysis of the tibia into the epiphyseal line at its inner end. Eleven months after it was noted that the external malleolus was prominent and that the tibia was three-eighths inch shorter than that of the uninjured side. Premature ossification had not evacuated at the time the last X-ray was taken one year and nine months after injury. At present, over two years after injury, the boy has five-eighths inch shortening of his tibia which he compensates by tilting the pelvis. The fibula is not shortened, the result being that the external malleolus is prominent and nearer the sole of the foot on the injured side. He is working as an errand boy without disability.

THE PROGNOSIS IN EPIPHYSEAL LINE FRACTURES

DR. MORRIS K. SMITH read a paper with the above title, for which see page 273, ANNALS OF SURGERY, February, 1924.

DR. JAMES MORLEY HITZROT called attention to Doctor Smith's observation that there was very little difference in the result when a portion of the diaphysis came away with the epiphysis. In his (Doctor Hitzrot's) experience this variety was less likely to produce disturbance in growth, than those injuries confined to the conjugal cartilage alone. One should be careful of the prognosis. He once had a case where there was very little displacement of the lower radial epiphysis in which he sent the X-ray picture to the patient's father, who was a physician, to show the good result. There is now quite a deformity due to premature ossification, for which Doctor Hitzrot is considered responsible.

Doctor Hitzrot showed the X-ray film of the result of a separation of the lower right femoral epiphysis nine years after injury. The case was recently referred to him by Doctor J. H. Cudmore with the history of an injury to the right femoral epiphysis, when the boy was not quite nine years old. This was apparently perfectly reduced at that time. About six months after the injury it was noticed that the leg was not as long as its opposite and not as well developed. This difference in length has been steadily increasing. The boy is now not quite eighteen years old and the difference in length is two and one-half inches plus. The X-ray shows very beautifully a premature ossification of the lower femoral epiphysis with a lack of growth in the bone, both in the longitudinal and in the transverse plane.

The cases of femoral epiphyseal separation are not common, but they are bad cases and make an impression out of proportion to their number, and the ultimate result when premature ossification occurs is very distressing to the patient.

DR. RICHARD W. BOLLING expressed his belief that the natural tendency to correction of deformity should be considered, especially when the question of treatment comes up in cases of epiphyseal separation seen late, or when

only incomplete reduction has been obtained. A case in point was that of a child of eight years, seen sixteen months ago with a history of injury to the knee four weeks previously. A röntgenogram showed a partial dislocation backward of the lower femoral epiphysis. In view of the fact that union had advanced, no attempt was made to correct the deformity, but the knee was immobilized for five weeks and the patient discharged in nine weeks. At the end of eight months there was perfect function and the normal contour of the femur had been restored.

Stated Meeting Held December 12, 1923

The President, Dr. Eugene H. Pool, in the Chair

BONE PEGGED FRACTURES OF NECK OF FEMUR

Dr. Edwin Beer presented four patients with fractures of the neck of the femur in which a bone peg had been introduced about four years ago under spinal anæsthesia.

The four cases presented were operated upon by Dr. George Cahill and Dr. Edwin Beer about four years ago. They were not shown with the object of stimulating operative treatment of this type of injury, but with the object of presenting average end results following operative treatment. The cases were done to really see what operative treatment would accomplish, and he was free to confess that although all four patients had useful, serviceable limbs, an ideal functional result was not obtained. Ideal functional results are claimed by the enthusiasts for all types of treatment, whether the enthusiasts followed the Whitman abduction treatment, or whether they followed the abduction treatment with forceful impaction of the fragments as advocated by Cotton, as well as when bone-pegging has been used.

Case I.—(Fig. 1.) Joseph Parker, age fifty-two, was admitted September 2, 1919, with a fracture of the neck of left femur (non-impacted), complicated by diabetes. At the end of three weeks a bone peg from tibia was introduced into the fractured neck of femur under spinal anæsthesia, neck being exposed through an anterior incision and the drill being introduced through a lateral incision through base of trochanter and driven into head of bone. Excess material of bone peg was broken up into small fragments and these were introduced into fractured area as well as about same. Patient was placed in moderate abduction in plaster for ten weeks. Thereafter patient wore brace to April 20, 1920. Then used crutches to May 15, 1920; and thereafter used cane.

When last seen on October 19, 1923, he had a limp. Shortening is between one-half to three-quarters inches. Walks without cane and can stand with full weight, 200 pounds plus, on broken leg. Flexion at hip is to almost 90 degrees. Internal and external rotation almost complete. Abduction to approximately 30 degrees. X-ray this date (Fig. 1) shows bone peg is still visible—four years after operation.

Case II.—(Fig. 2.) Benjamin Williams, age fifty, was admitted October 28, 1919, with a non-impacted fracture of the neck of femur. Under spinal anæsthesia, a bone peg was inserted November 13, 1919, as in Case I. The bone peg was very thin, the cortex of the tibia being unusually thin. Leg put

up in moderate abduction, proper position having been determined, as in previous case, when fractured surface was exposed.

January 28, 1920. X-ray showed considerable bone formation and a fracture of the bone peg. Patient developed peripheral neuritis in both arms, which delayed the use of crutches.

October 18, 1923. X-ray (Fig. 2) shows bone peg still visible. There is considerable new bone formation in and about region of injury. The man

FIG. 1.—Case I.

walks readily eight to nine blocks, never more than a half mile at a time, as hip gets sore if he walks too much. Flexion at hip is to almost 90 degrees. Internal and external rotation at hip are good but abduction is lost, though the neck of the bone as seen in X-ray (Fig. 2) is fairly satisfactory, the small fragment of bone placed about the fragments, together with the broken peg which allowed of some angulation, have prevented the retention of good abduction.

CASE III.—(Fig. 3.) Mrs. Mary O'Brien, age fifty-eight, was admitted November 2, 1920, with a non-impacted fracture of the neck of left femur. On the following day, under spinal anæsthesia, the neck of the femur was pegged as in the previous cases, and put up in moderate abduction. Patient also made an uneventful recovery.

October 18, 1923. Patient reëxamined. Uses cane on streets. Has occasional pain. Motion at hip is good. Flexion, extension and rotation

at hip are good but abduction is very slight owing to extensive bone formation in fragments placed about neck of femur at time of operation, very much the same picture being produced as in Case II.

CASE IV.—(Fig. 4.) Mrs. Agnes Goodwin, age thirty-six, was admitted March 29, 1919, with a non-impacted fracture of the neck of the right femur. She was treated for almost nine months with a plaster case in abduction. The treatment did not lead to any union. January 8, 1920, under spinal anæsthesia

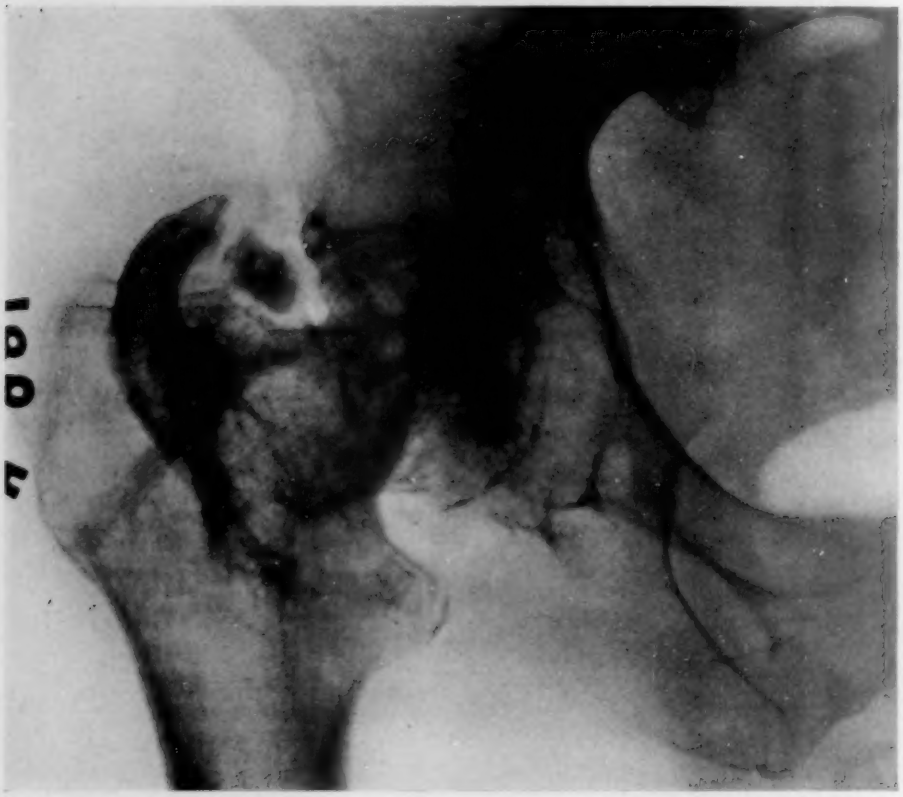

FIG. 2.—Case II.

with a small amount of ether, a bone peg was introduced as in the three previous cases, and the limb put up in plaster-of-Paris which was maintained for about three months. It was interesting to note that as a result of attempts at moving the broken leg, there had been almost complete absorption of the upper part of the neck so that at operation the upper fragment in addition to the head presented very little more than a shell of bone at the inferior aspect of the neck. This cavity was filled with bone fragments derived from excess material of the bone peg. After removing the case, as in the previous cases, the patient was encouraged to exercise while lying in bed. Gradually she began walking, first using crutches, then cane, and was at last allowed to bear her full weight on the broken hip six to nine months after operation.

October 23, 1923. Despite marked absorption of bone encountered at operation, patient has excellent functional result. She can walk without cane, has no pain, none or very little shortening, though there is a slight limp.

Flexion is complete and abduction good. The X-ray of this date (Fig. 4) shows very fair result with bone peg still in place and well-marked lines of calcification running down from head into shaft.

Dr. Royal Whitman said that at the time of the introduction of the abduction treatment it was the established belief, that fracture of the neck of the femur was an exception to all others, in that its treatment on surgical

Fig. 3.—Case III.

principles was both futile and hazardous. If it were intracapsular non-union was inevitable, if impacted the deformity must be protected regardless of its effect on function. In short, to quote from a modern treatise on fractures, "the ideal object of treatment, restoration of form and function, was rarely to be attempted or even sought." The results have been so extraordinarily bad that they have served to uphold the theory and practise that produced them, thus forming a homogeneous interdependent structure, that like the wonderful one-horse shay couldn't break down because it had no weakest part. "For the back crossbar was as strong as the fore and the whipple tree neither less nor more."

The actual basis of this belief and teaching has been the inadequacy of conventional methods to provide the opportunity for functional repair. For

since the neck of the femur projects laterally from the shaft, splinting and traction can at best appose the fragments only in a lateral and therefore insecure relation.

The abduction method utilizing the mechanics of the joint enables one to correct deformity and to adjust displaced fragments, consequently surgical principles have been applied, regardless of the rules of practise adapted to

FIG. 4.—Case IV.

inadequacy; and the practical experience of the past twenty years has disproved all the conclusions on which they are based. Union is possible and probable in any form of fracture regardless of the age of the patient, if the opportunity is assured. The immediate correction of deformity does not endanger repair, but favors it by apposing the fractured surfaces. The treatment of the fracture as a fracture does not endanger life. On the contrary, it is far more conservative than life-saving neglect. In short, it has been demonstrated that fracture of the neck of the femur differs from other fractures only in the sense that it stands first in the therapeutic scale, as the fracture which because of the greater physical, mechanical and nutritive obstacles to success that it presents, is on this account the fracture in which the result is most directly determined by the efficiency of the treatment. A

method is now available by which the opportunity for repair may be attained and physically demonstrated and for this primary essential of success the one who undertakes the treatment of the most disabling of all fractures may now be held responsible. In other words, conventional authority can no longer assure immunity for incompetence and neglect.

DR. H. H. M. LYLE said that he had no personal experience with the bone-peg treatment of fracture of the neck of the femur, but he could conceive that this method might have a narrow field of application. It had been his practice to employ the Whitman abduction method in the treatment of fractures of the neck of the femur, since it was first introduced into St. Luke's Hospital, by the late Dr. Francis Markoe. In this time there had only been two failures, and strange to say these had occurred within the last three years. Both of these failures were not caused by the method, but by faults in the after-treatment. One was a refracture due to the fact that while the patient was still on a walking brace the attendant, without orders, removed the perineal support, thus bringing the full weight on the recently united fracture. The second failure was in a case of an associate; afterwards this case had a reconstructive operation performed by Doctor Whitman.

DOCTOR WHITMAN said that it was apparent in all the Röntgen pictures of Doctor Beer's cases that the angle of the bone peg on the trochanteric side of the fracture did not correspond with that of the inner fragment, indicating that it had either been broken or absorbed during the process of repair, thus permitting a depression of the neck and consequent limitation of abduction. The retention of a fair range of abduction was only secondary in importance to the attainment of union. The ability to separate the limbs symmetrically was the first essential of stability if the base were uneven or insecure, and it was also essential for a normal gait as illustrated by the patients presented, the marked limp being explained in great part by the loss of this range and by the compensatory tilting of the pelvis. Doctor Whitman believed that the field for bone pegging, either primary or secondary, was very small. The cases in which it was performed were always of a favorable type, a class in which natural repair was the rule if the opportunity were assured by efficient treatment.

As evidence bearing on the question of natural repair, he would accept only an X-ray picture taken through the plaster after the application of the abduction treatment showing apposition of the fragments in normal relation. If under such conditions union had failed, he would consider the outcome of secondary bone pegging so uncertain that he would advise a reconstruction operation, more especially as the functional results of this procedure may be compared not unfavorably with the cases presented.

DR. EDWIN BEER, in answer to a question, stated that the four cases presented by him were in bed in plaster from eight to ten weeks, then for two weeks longer in bed without plaster, and after three months or thereabouts, the patients began to move about on crutches, the two males having a steel brace.

The functional result in the late ununited fracture (Case IV) appeared to Doctor Beer to be the best result in this series, although he was free to admit that not one of the four cases had as perfect a result as the literature on bone pegging suggested as the usual outcome. The fact that abduction was limited or almost absent in two of the cases was readily explained, in part at least, by the fact that the fragments of bone placed at operation about the neck of the femur, undoubtedly, produced a certain amount of new bone which blocks abduction. In addition, as the X-rays in these two cases show, the angle of the neck has been markedly changed in the sense of coxa vara, perhaps by too early weight-bearing which began in three of the cases in the fourth month. Although Doctor Beer was not advocating operation as a routine procedure in these cases, as many of these patients were much too old for operative interference even under spinal anæsthesia, he felt that early rapid union with weight-bearing power and fair function could be obtained by this method and would probably be necessary and advisable in all suitable cases and when the abduction treatment had failed to give a good union. It is surprising at operation to find many of these fractures of the neck of the femur are comminuted fractures, though X-ray fails to show but two main fragments. Until Doctor Beer had seen impacted fractures of the neck of the femur that had been broken up and treated by the abduction method in whom good functional results had been achieved, as far as breaking up impactions was concerned, he would still prefer to leave these patients impacted. At some future date he hoped Doctor Whitman would oblige the Society by showing some of his end results.

GOODWIN'S ARTHROMETER

Dr. H. H. M. Lyle demonstrated Goodwin's arthrometer for the simultaneous measurement of the metacarpal and phalangeal joints. Figure 1, shows the instrument. Figure 2, shows the method of using the arthrometer.

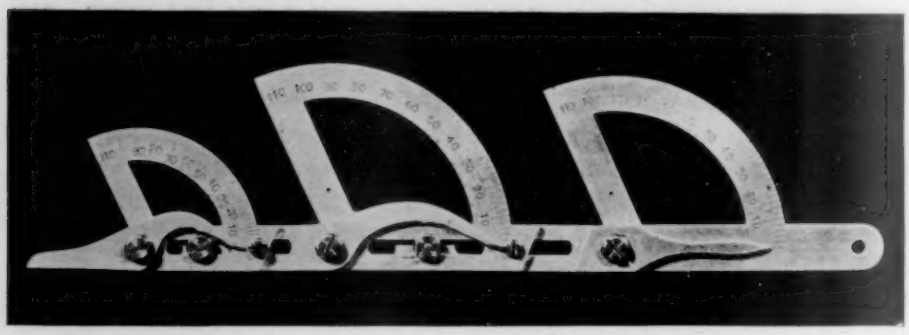

Fig. 1.—Goodwin's arthrometer.

A convenient way to employ this instrument in the measurement of stiff joints is to first measure the joints of the corresponding normal finger and express their relation to the contracted finger in fractional form. For exam-

ple, if the normal terminal phalangeal joint has a flexion of 50°, the interphalangeal joint of 80° and the metacarpo-phalangeal joint 30° and the corresponding pathological finger joints a flexion of 10°–40°–15°, it would be written— $\frac{10^\circ}{50^\circ}\ \frac{40^\circ}{80^\circ}\ \frac{15^\circ}{30^\circ}$ In this way an accurate record of the improvement can be kept. The advantages of this arthrometer are self-evident; at one

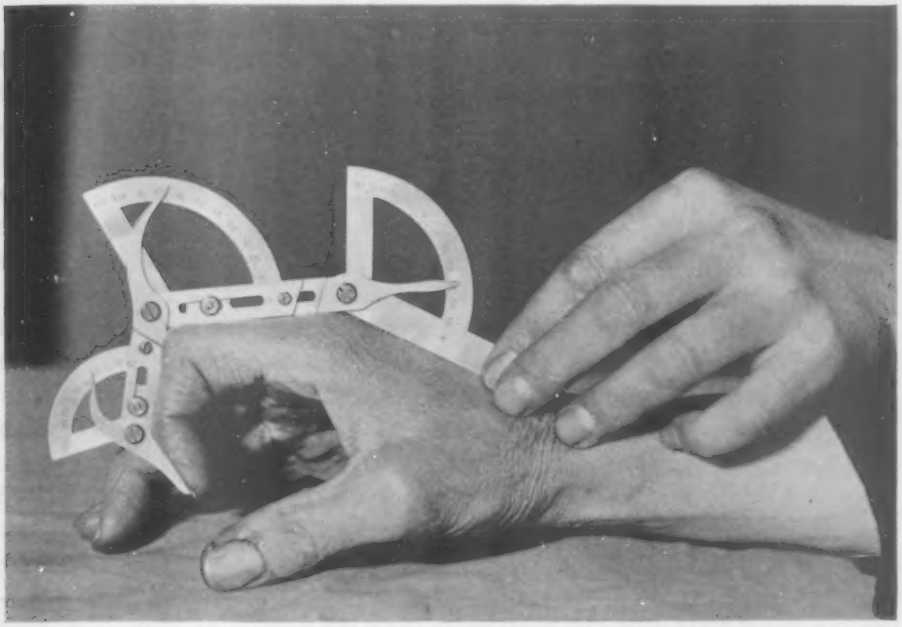

FIG. 2.—Method of using arthrometer.

glance the measurement of each individual joint can be obtained, or if desired, an accurate tracing can be made. It has a marked field of usefulness in detecting malingering as it is extremely difficult for a patient to flex all the joints of the supposedly affected finger to exactly the same angle. Accurately recorded measurement by this instrument will soon uncover any shamming.

THE OUTCOME OF INFECTIONS OF THE BILIARY TRACT

DR. WALTER MARTIN read a paper with the above title, for which see page 424.

DR. ALLEN O. WHIPPLE said that Doctor Martin had summarized in one sentence, the principles that should be the guide in the removal of the gall-bladder. Reasons for removing the gall-bladder are when stones are present or when there is a well-recognized lesion; and the reason for not removing the gall-bladder is when no recognizable lesion is present. The point which it seemed to him had not been sufficiently emphasized in the discussion of the association between chronic cholecystitis and chronic appendicitis, was the difficulty of determining real lesions in gall-bladders without gall-stones, and in deciding what was a chronically inflamed appendix. To say that the large

proportion of appendices show lesions or are found to be associated with lesions of the biliary tract is based largely upon the individual's estimate of what chronic appendicitis is. There certainly is no real agreement as to just what is chronic appendicitis. This, in the speaker's opinion, was the weak point in Graham's work in connection with the liver, inasmuch as Graham has given too little consideration to what constitutes real pathology in the appendix in its rôle as a channel or portal of entry of infection.

Dr. Frank S. Mathews said that in spite of some recent papers which have brought the question before the medical public, he considered that the question of the advisability of the removal of the gall-bladder in stone cases, had been settled in favor of cholecystectomy. The only objection to the more radical operation is from the occasional damage that may be done to the common duct, very rarely in the hands of capable surgeons, but not infrequently in the hands of inexperienced. He thought there might still be room for difference of opinion as to the advisability of removal of gall-bladders which depart but slightly from the normal. It seems difficult to believe that the gall-bladder showing the slightest evidence of inflammation can be the cause of pronounced symptoms, when we so frequently find gall-bladders showing most marked evidence of chronic inflammation in which both local and remote symptoms are conspicuously absent. He has never been impressed by the diagnosis of "chronic appendicitis" either as a pathological or clinical entity, and would consider that at the present time there is not sufficient evidence to show that chronic disease of the appendix is responsible for gall-bladder disease. In acute appendicitis, gall-bladder liver infections seem quite conspicuously infrequent, even as compared to such local infections as perinephritic and subphrenic abscess. He believed that at the present time the tendency of the medical profession is to attach undue importance to the appendix, cicatrized tonsils, and slight peridental inflammations. The tendency seems to attribute remote symptoms of the nervous and vascular systems to these structures in the absence of any definite local inflammatory symptoms and signs.

Dr. Charles Gordon Heyd thought that it was necessary in describing conditions in the gall-bladder to differentiate between surgical and pathologic nomenclature. A surgeon might believe a gall-bladder pathologic and meriting removal and yet the pathologist describes it in terms quite different. Furthermore, that he had referred to hepatitis, but did not wish it to be understood that the type of hepatitis that was associated with chronic inflammatory disease of the abdomen was a clinical entity, or had a clinical symptomatology. Yet hepatitis did exist and it did not invalidate the finding by the inability to trace the course of the infection from its source to its final injury in the liver no more than one could trace the course of a nephritis from its beginning up to urinary suppression. In regard to the clinical signs of appendicitis it would be necessary to differentiate the two types of appendices, the infantile type with a widely dilated valve of Gerlach would allow

intracæcal drainage quite readily and yet not give clinical symptoms, but would probably show pathologic changes in the form of round-cell infiltration. It had been the experience of Doctor Heyd that the effect upon the gall-bladder of drainage was, as a rule, to increase the fibrotic elements in it and there was a distinct danger to the individual in leaving a chronically infected gall-bladder *in situ*, even if it had presumably been adequately drained. When Eisendrath reported 61 cases of injury to the common duct during the course of cholecystectomy and these injuries in the hands of very capable men it certainly was an argument for leaving the gall-bladder in place if it represented only minor degrees of pathologic change. Yet a gall-bladder that needed drainage many times required a second operation at some future time and this second operation certainly carried with it more danger of injury to the common duct at that time than did a primary cholecystectomy. Doctor Heyd thought that where the wall of the gall-bladder showed mural changes that was a gall-bladder that should be removed.

Dr. Edwin Beer said that it was generally conceded that in the general circulation, bacteriæmia occurred with some frequency, and such bacteriæmias, also well recognized, might be very transient as in the syndrome of furunculosis and cortical kidney abscess. Probably in the portal circulation very similar invasions took place. Autopsy material did show in some work done years ago, numerous instances of miliary tuberculosis of the liver in the absence of general miliary tuberculosis. In view of the fact that large tubercle lesions are rarely seen in the liver, it is presumable that the liver takes care of many of these tuberculous infections which probably originate in a tuberculous entero-colitis. In the production of cirrhosis of the liver it is, although as yet not proven, highly probable that bacteria may through the portal system reach the liver and there produce focal necrosis (followed by cirrhosis) having wandered through the diseased or chronically inflamed mucous membrane of the gastro-intestinal tract. It is highly probable that portal bacteriæmias are fairly frequent and possibly of no great significance. As yet, however, no definite method of clinical investigation of this problem has been elaborated.

A second point was in connection with the study of gall-stone formation. There seemed to be a very beautiful analogy between the formation of pure cholesterin stones in the uninflamed bladder and the formation of uric acid stones, or uratic stones, in the urinary bladder. Both form in non-inflamed organs, and probably only in cases in which stagnation of bile or urine is present. Probably due to some physical or chemical change in the colloidal solubility, stones of this type form in these two organs. The secondary stones, which form after infection has been super-added, are regularly of different composition; in the urinary bladder phosphates, and in the gall-bladder bilirubin calcium with or without cholesterin.

A third point was in connection with the presence of non-palpable symptomless stones in the common duct. There was no doubt that such stones

occur and can be the cause of symptoms after cholecystectomies without drainage and exploration of the common duct. He has repeatedly removed such stones and when doing such common duct explorations as a routine, he was surprised at the goodly percentage of such stones removed. About ten years ago he had shown a series of such cases to Dr. W. J. Mayo, who had expressed some surprise. A little later, a similar series was seen by another surgeon, who, apparently following this lead, had subsequently published along these lines. Doctor Beer himself had not as yet brought together his cases. Further study had, however, suggested to him that some of these cases had stones in the common duct which probably were pushed in through the cystic duct during gall-bladder manipulations. Since adopting the technic of constricting the cystic duct with catgut loops prior to cholecystectomy, a certain proportion of these quiescent common duct stones had been eliminated.

The fourth point worth mentioning was the possibility that some patients who have had common duct stones, may have recurrent symptoms as the result of the intra-hepatic stone formation. Such stones if small, and usually of bilirubin calcium, are liable to form behind a common duct obstruction, if a mild degree of cholangitis develops, and, as he has seen repeatedly, such stones wander down from the branches of the hepatic ducts producing colics, with or without transient jaundice, as they wander from the liver into the intestine. Only recently a patient with this pathology came to examination and a large number of such intra-hepatic stones were found in the dilated radicles of one of the hepatic ducts.

Doctor Martin, in closing the discussion, said he believed all grossly infected gall-bladders and all gall-bladders containing stones should be removed unless there was an obvious contra-indication. The difficult question, to his mind, was the determination of the lesion of the gall-bladder wall. He thought it a good rule to confine oneself to removing only gall-bladders that gave outward and visible signs of infection.

In regard to the points raised by Doctor Beer as to the frequency of portal infection, he would refer to the work of Adami and his co-workers. They found very frequently low-grade infection of the liver from portal sub-infection. In regard to stones being pushed through the cystic duct into the common duct when the gall-bladder was removed, he was sure that it often happened and that one should be cautious in making rough manipulations and squeezing the gall-bladder until the cystic duct was isolated and clamped.

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